Ethernet Packet Generator

TCL API GUIDE

Version 1.0

APG4 APG8 APG200 APG208

Software Revisions

This document applies to the following software versions:

APG TCL API	Embedded Software	FPGA
Version 1.0.0	Version 2.0	Version 6.010B

Revision History

Date	Version	Changes
12 August 2016	0.8	Restricted customer release
7 June 2017	1.0	General Release • Added APG200 • Added Timestamp Analysis (see Section 3.7) • Added API Initialisation (Section 4) • apgGetVersion renamed to apgGetApiVersion (Section 4.2) • apgOpen waits for unit ready (Section 5.1.1) • Removed inconsistencies in apgSaveConfiguration PORTLIST (see Section 6.1.1) • RXTIME replaces TIMESTAMP in apgGetPort CAPTURE PACKET command (see Section 8.2.8) • apgSetPort command simplified (Section 8.3.1) • Added apgSetPort TOPOLOGY command to enable switching between 40G / 4x10G modes (Section 8.3.1) • Added Deep Packet Capture (see Section 8.1.3) • Added Packet/Second Transmit Rate (Section 9.3.2) • Added Multi-Burst Transmit Mode (Section 9.3.2) • apgLoadStream command modified (Section 9.1.1)

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Document Conventions

INFORMATION:
Additional information to clarify functionality or usability

WARNING:
Clarification of unexpected or restricted functionality

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Preface

About This Document

This manual describes the structure and commands of the Axtrinet TCL API, and contains the following sections:

Section	Description
1. INTRODUCTION	Summary of the TCL API interface and capabilities
2. INSTALLATION	Installation procedures for the Microsoft™ Windows™ and Linux drivers and TCL API Interface
3. TEST ENVIRONMENT	Introduction to Ethernet packet generation, packet structures and control
4. API INITIALISATION	Initialising the APG TCL API and version command
5. CONNECTION COMMANDS	Open and Close connections to the APG units
6. CONFIGURATION COMMANDS	Save and Apply unit configurations
7. UNIT COMMANDS	Unit-level connection, load, and get TCL commands
8. PORT COMMANDS	Port-level configuration load, get, set and apply TCL commands
9. STREAM COMMANDS	Stream-level configuration load, get, set and apply TCL commands
10. TOOLS	Command and Header tools to simplify access to the internal database variables

Related Documentation

[1] APG-GSG Axtrinet Getting Started Guide

[2] APG-UG Axtrinet User Guide (including APG Control Interface)

[3] APG-HDR Axtrinet Header Definitions

[4] APG-SW-TC Axtrinet APG Software License Terms And Conditions

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Glossary

APG	Axtrinet Packet Generator
API	Application Programming Interface
FCS	Frame Checksum
IBG	Inter-Burst Gap
IFG	Inter-Frame Gap
pps	Packets per Second
QSFP+	Quad Small Form-Factor Pluggable (40Gbps)
RPM	Revolutions per Minute
SFD	Start-of-Frame Delimiter
SFP	Small Form-Factor Pluggable (1Gbps)
SFP+	Small Form-Factor Pluggable (10Gbps)
TCL	Tool Command Language
USB	Universal Serial Bus

Contents

1. INTRODUCTION

Thank you for purchasing an Axtrinet™ APG Ethernet Packet Generator.

The Axtrinet APG Ethernet Packet Generators provide compact and affordable 40Gbps and 10Gbps Ethernet Packet Generator/Analysers with a simple-to-use Control Interface and an open TCL API for third party scripting.

Ideally suited to applications in R&D, Test and Manufacturing environments, and 'on the road' with Field Sales and Application Engineers, the Axtrinet APG Ethernet Packet Generators allow reliable and affordable development and testing of:

- Ethernet network equipment such as switches, routers, firewalls and network monitoring devices
- Data storage equipment with 10Gbps and 40Gbps Ethernet interfaces
- Specialist devices such as FPGA accelerator NIC cards and offload appliances
- Ethernet infrastructure installations encompassing cabling and switches

1.1 MAIN FEATURES

- Highly configurable Ethernet Packet Generation
- Full wire-speed operation on all ports
- Industry standard QSFP+ and SFP+ ports
- Real-time packet counts and error detection
- Packet Capture for post-test analysis
- Simple to use Control Interface for configuration and control
- Clear LED status indication for unit operation and Ethernet traffic generation/reception
- USB 2.0 port for easy set up and local management and 10/100Mbps Ethernet LAN connection for flexible remote management

1.2 BENEFITS

- Low cost allows multiple units to be deployed in a development environment – one per desk
- Easy to set up and use. Avoids the need for complex vendor specific programming skills
- Ideal for integration into a manufacturing test environment using TCL scripting interface
- Flexible choices of interfaces allows use with different speeds and media types, maximising the investment across multiple projects
- Small size, 1U high (44mm) and 146mm wide, for desk-top or rack shelf mounting (1/3 rack width)

1.3 TRADEMARKS

1.4 Software Licences and Support

See the Axtrinet APG Software License Terms & Conditions [4]

Email based software support is included in the purchase price for the first 12 months after delivery. Extended Software Support is available for purchase; please contact Axtrinet or your reseller for more information.

1.5 Contact Details

Technical assistance is available from Axtrinet at the following address:

Address: Xentech Solutions
Suite 6 Stanta Business Centre
3 Soothouse Spring
St Albans
AL3 6PF
UK

Phone: +44 (0)1727 867795

Email:
Technical Support: **support@axtrinet.com**
Sales: **sales@axtrinet.com**

Web Site: **www.axtrinet.com**

2. INSTALLATION

APG TCL API installation process on a host PC running Linux or Windows is described in the APG User Guide [2] Section 2.

2.1 MINIMUM SYSTEM REQUIREMENTS

Processor	Pentium-class processor or equivalent
Memory	2GB (4GB recommended)
Disk Space	15MB
OS	64bit (x86_64) Linux systems Microsoft Windows 7 Microsoft Windows 8.x Microsoft Windows 10.x
Interfaces	Minimum: USB 2.0 Preferred: USB 2.0 & 10/100Base-T

2.2 PREREQUISITES

In the Windows Environment, a TCL distribution (such as Activestate® ActiveTcl) must be installed before using the APG TCL API.

In the Linux Environment, the TCL package for your 8.6.x distribution must be installed before using the APG TCL API.

2.3 TESTING THE INSTALLATION

2.3.1 Windows Environment

The Axtrinet TCL package is installed in **C:/Program Files/Axtrinet/APG/tcllib**

To test the installation, run "test.tcl" in the /examples directory:

```
% cd C:/Program Files/Axtrinet/APG/examples/
% tclsh test.tcl
APG TCL API V1.0.0
Build Date 1496403379
Target API Version 161016
```

The Axtrinet TCL API has been successfully installed if test.tcl completes without errors, and displays the API version, build data and target API version.

2.3.2 Linux Environment

The Axtrinet TCL package is installed in **/usr/share/axtrinet/apg/**

To test the installation, run "test.tcl" in the /examples directory:

```
$ ./usr/share/axtrinet/apg/examples/test.tcl
APG TCL API V1.0.0
Build Date 1496403379
Target API Version 161016
```

The Axtrinet TCL API has been successfully installed if test.tcl completes without errors, and displays the API version, build data and target API version.

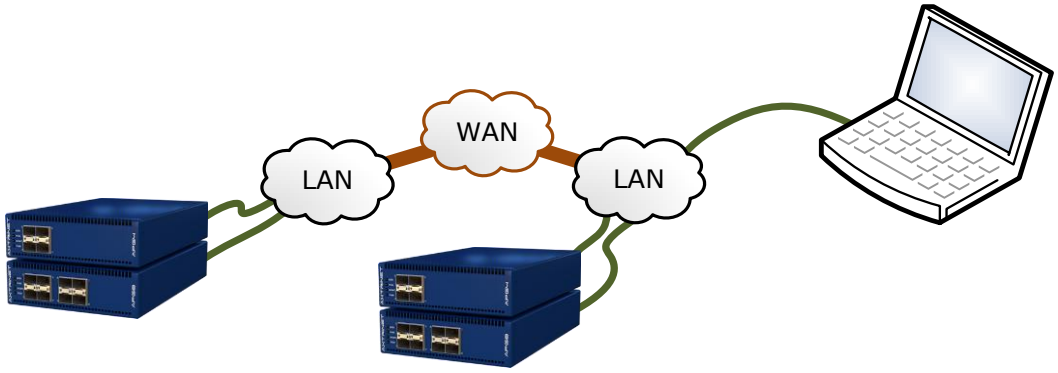
2.4 EXAMPLE FILES

Example files are provided in the demo directory that can be run within your TCL environment:

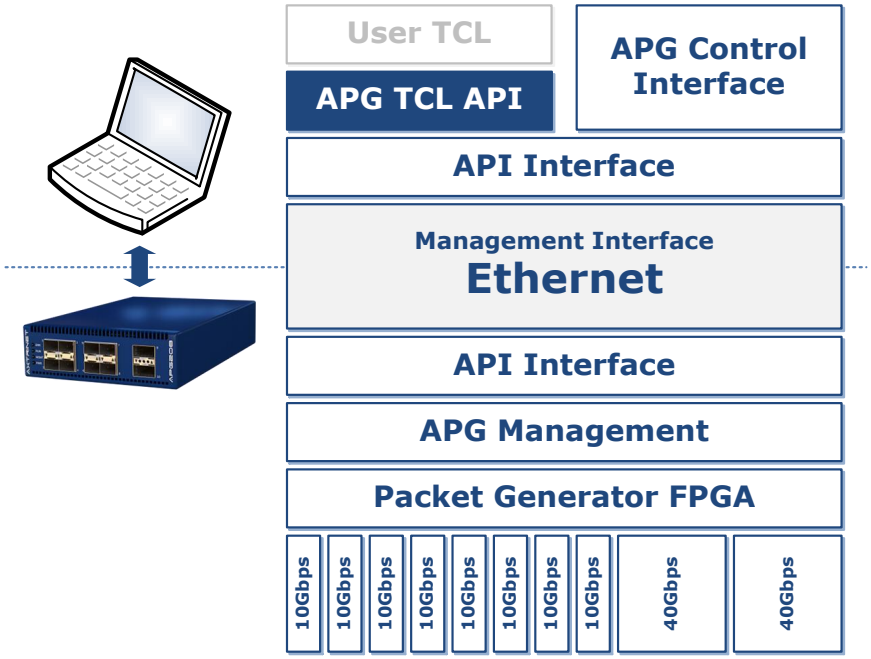
1.	demo_init.tcl	Initialise Axtrinet APG API Package
2.	demo_connection.tcl	Open and Close connections to the Axtrinet APG
3.	demo_save_recall.tcl	Save and load port and stream configuration
4.	demo_unit_commands.tcl	Load and display unit information
5.	demo_port_commands.tcl	Load and display unit and port information. It includes the following examples:
	a) demo_generate_portlist.tcl	Generate list of unit ports and streams
	b) demo_configure_stream.tcl	Configure streams and apply to unit
	c) demo_port_control.tcl	Start/stop traffic, calculate rates, capture packets
	d) demo_port_counters.tcl	Read and display port counters and rates
	e) demo_port_capture.tcl	Read and display captured packets

3. Test Environment & Concepts

The Test Environment consists of one or more Axtrinet Packet Generators. The APG TCL API can connect to single or multiple units over the Ethernet management interface. The units may be located in the same location, or in geographically separate locations connected by a WAN.



All accessible units can be managed through the same Control Interface or TCL scripting interface. The APG TCL API and the APG Control Interface share the same API to the Axtrinet Packet Generator:



The APG TCL API only runs over the Ethernet Management Interface.

The Axtrinet APG API provides a TCL scripting interface for automated test generation.

The API provides access to:

- unit, port and stream configuration and status
- packet counters (packets, bytes, errors)
- receive filters and packet capture tools
- port control (start, step, stop)

The Axtrinet APG Control Interface is described in the APG User Guide [2].

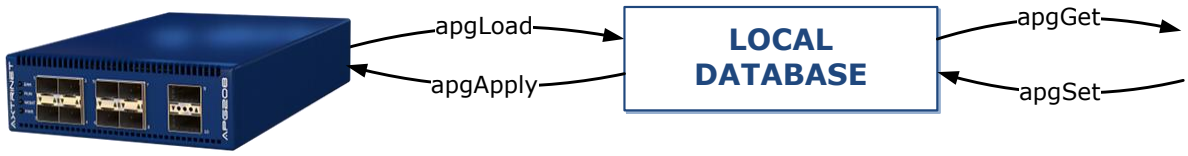
3.1 DEFINITIONS

UNIT	A unit is a single physical Axtrinet Packet Generator (APG4, APG8, APG200 or APG208). A unit is assigned a UNITID when the management connection is first opened using the APG TCL API. The UNITID is fixed for the duration of the TCL session, and is used to uniquely identify a unit during the session. The UNITIDs will be reassigned if the TCL session is restarted. Unit commands enable management connections; provide access to the unit status (See Section 4).
PORT	A PORT is a physical aperture on the unit (SFP+ or QSFP+). Ports are numbered from 1. The UNITID is used in conjunction with the PORT number to create the PORTID (eg Unit 2, Port 7 has a PORT ID {2 7}). The PORTID is fixed for the duration of the TCL session, and is used to uniquely identify a port during the session. Port commands allow access to the modules; port capabilities and configuration; and port counters (see Section 8).
SUBPORT	Where a QSFP+ port can be configured into different topologies (eg 40Gbps or 4x10Gbps), the PORTID is qualified with a SUBPORT. Subports are numbered from 1. The UNITID is used in conjunction with the PORT and SUBPORT number to create the SUBPORTID (eg Unit 3, Port 10, Subport 1 has a SUBPORT ID {3 10 1}). The SUBPORTID is fixed for the duration of the TCL session, and is used to uniquely identify a port during the session. Subports use the Port commands to gain access to the modules; port capabilities and configuration; and port counters (see Section 8).
MODULE	A MODULE is a SFP+ or QSFP+ transceiver, and must be inserted into a port aperture to enable a link. Module configuration and status are accessed with the Port Commands (see Section 8)
STREAM	A transmit stream generates a controlled number of Ethernet frames with a defined length and rate; fixed header configuration with a fixed or varying header contents; and a fixed or varying payload. The UNITID and PORTID are used in conjunction with the STREAM number to create the STREAMID (eg Unit 1, Port 3 Stream 2 has a STREAMID {1 3 2}). When a port has subports, the SUBPORTID is also required to form the STREAMID (eg Unit 1, Port 9, Subport 2 Stream 6 has a STREAMID {1 9 2 6}). The STREAMID is fixed for the duration of the TCL session, and is used to uniquely identify a stream during the session. The outputs from the eight stream generators are multiplexed into a single stream for transmission from a port. Stream commands allow the stream configuration to be read from the unit, modified and written to the unit (See Section 9)

3.2 APG CONFIGURATION

The 'master' unit, port and stream configurations are stored on the Axtrinet™ APG unit.

The TCL API uses a 'local' database to store the current and modified configurations, before being applied into the unit.



The TCL API provides the tools to **apgLoad** the APG unit configuration and status into the local database, read (**apgGet**) and modify (**apgSet**) the local database, and write (**apgApply**) to the APG unit.

The traffic generator is controlled with the **apgControl** command.

The unit retains its configuration over a power cycle.

3.3 PORT TOPOLOGY

Port Topology defines the physical port configuration (eg 40Gbps, 4x10Gbps), rather than the interface type (eg QSFP+).

Port topologies is changed with the **apgSetPort TOPOLOGY** command (see Section 8.3.1).

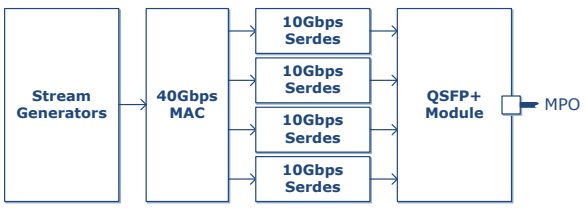
3.3.1 SFP+ Ports

The SFP+ Port Topology is fixed 10Gbps only.

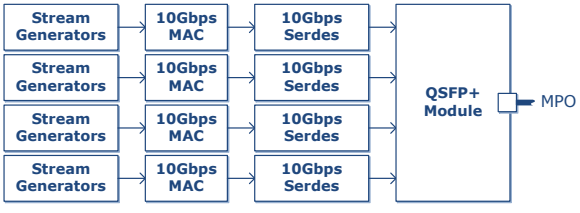
3.3.2 QSFP+ Ports

The QSFP+ interface topology can be configured in 40Gbps mode (default) or 4X10Gbps mode, where each of the 10Gbps lanes that comprise the 40Gbps link are managed independently.

Changing the port topology of a QSFP+ port changes both the transmit and receive paths.



a) QSFP+ Port in 40Gbps Topology (default)



b) QSFP+ Port in 4x10Gbps Topology

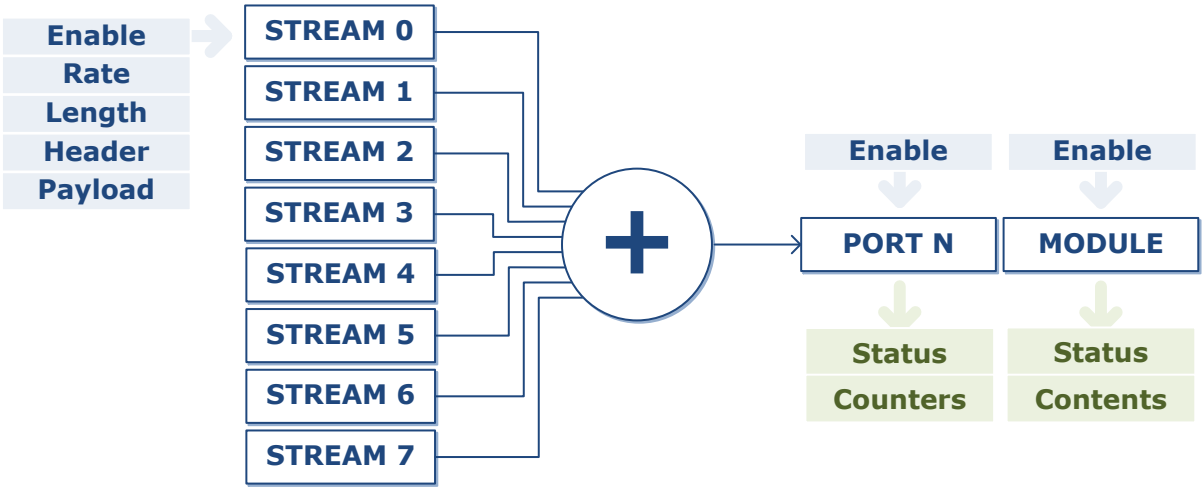
Switching between 40Gbps and 4x10Gbps topologies is performed with the **apgSetPort TOPOLOGY** command (see Section 8.3.1).

Mixed topology of the QSFP+ ports is **only** available with Port 9 at 4x10Gbps, and Port 10 at 40Gbps. Setting Port 9 to 40Gbps or Port 10 to 4x10Gbps topologies will automatically switch the other port into the same mode.

3.4 TRANSMIT CONFIGURATION

Each port contains a transmit engine that comprises:

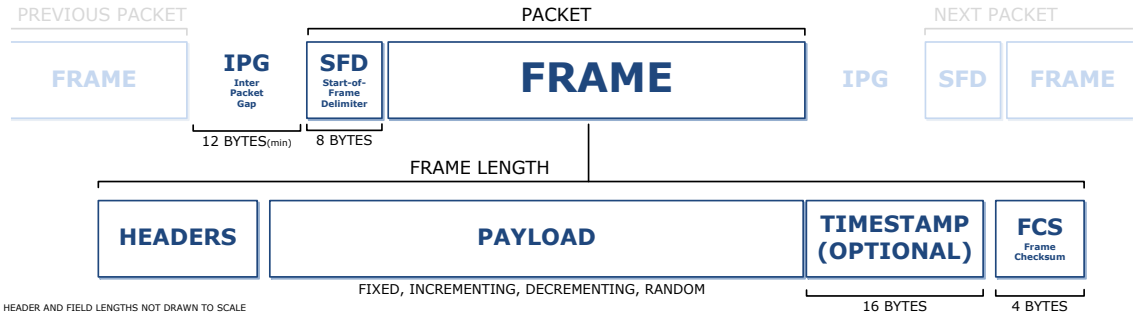
- 8 parallel independent configurable Ethernet stream generators
- Stream multiplexer
- Transmit port configuration and status
- Module configuration and status



The streams are processed in a round-robin sequence, transmitting a packet if it queued and ready to send.

To bring a link up, both the port and module must be enabled.
To transmit a stream, the port, module and stream must be enabled.
The transmit mode must be CONTINUOUS or a non-zero BURST.

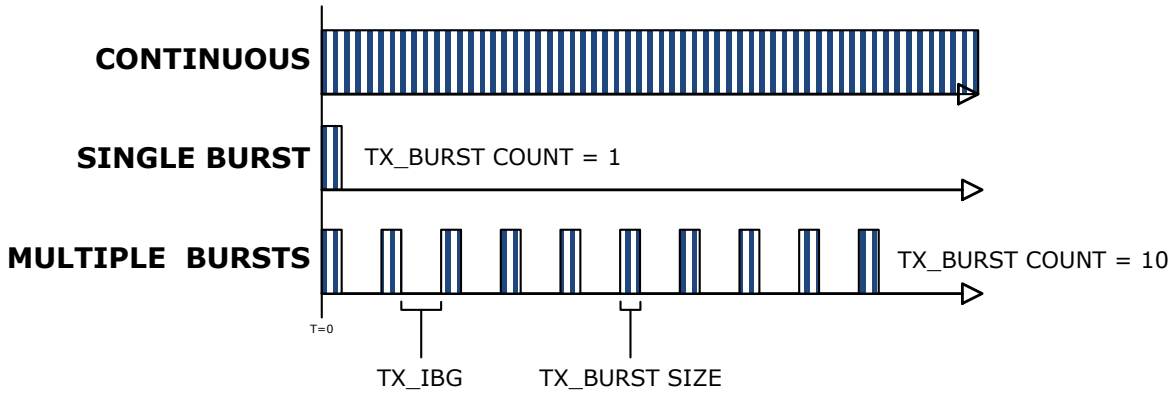
The Stream Generator defines an Ethernet frame:



A transmit stream generates a controlled number of Ethernet frames at a controlled length and rate; with a fixed header configuration, fixed or varying header contents, and a fixed or varying payload.

Streams can be enabled or disabled using **apgGetStream CONFIG**.

The stream transmit mode can be set using **apgSetStream CONFIG**, and defines how the packets are generated: either Continuously; as a Single Burst of **TX_BURST_SIZE** packets; or a Multiple Burst of **TX_BURST_SIZE** packets, repeated **TX_BURST_COUNT** times, separated by **TX_IBG.**



The stream transmit rate can be set using **apgSetStream CONFIG**. The stream rate can be set as in percent, packets per second or clock cycles.

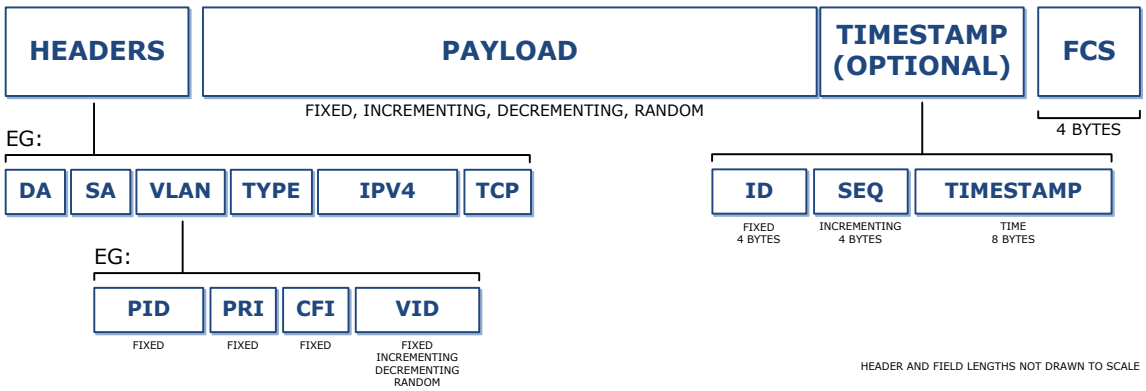
Care should be taken to ensure that the cumulative stream transmit rates does not exceed the port capacity.

If the cumulative stream transmit rates does exceed the port capacity, the port will transmit at wire rate, but the streams will transmit at a lower rate than configured.

The length defines the total length of the frame in bytes, including the headers, payload, timestamp (if enabled) and 4-byte Frame Checksum (FCS). The length can be fixed, or incrementing, decrementing or random over a range using **apgSetStream CONFIG**.

The HEADER is created by adding header types (eg MAC, VLAN, IPV4) to the stream using **apgSetStream HEADER HEADER_LIST**.

Headers can be configured using **apgSetStream HEADER**.



The payload can be fixed, or incrementing, decrementing or random over a range using **apgSetStream PAYLOAD**. The payload may additionally include a timestamp and sequence number.

The optional "Timestamp Fields" incorporating the timestamp ID, Sequence Number and Timestamp are enabled on a "per stream" basis using the apgSetStream **PAYLOAD TS_ENABLE** command, and processed using the **apgLoadPort ANALYSIS** and **apgGetPort ANALYSIS** commands.

To bring a link up, both the port and module must be enabled.
To transmit a stream, the port, module and stream must be enabled.
The transmit mode must be CONTINUOUS or a non-zero BURST.

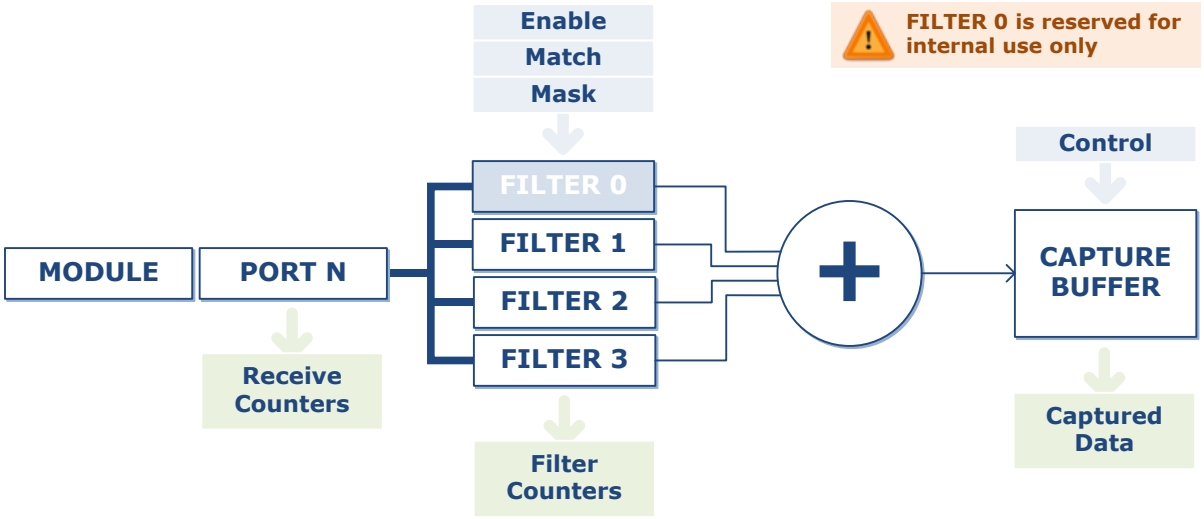
Port link status and link speed are accessible using **apgGetPort INFO** and **apgGetPort STATUS**, and the transmit counters can be read using **apgGetPort TXSTATS**.

A module can be enabled or disabled using **apgSetPort** command.

The module type, vendor and capabilities are accessible using **apgGetPort MODULE**.

The traffic generator is controlled with the **apgControl** command.

3.5 RECEIVE PATH



Each port contains a receive path that comprises:

- Module status
- Receive port status and counters
- Filter stream multiplexer
- Configurable Capture Buffer

The port receive counters can be read using **apgGetPort RXSTATS**.

Configurable Capture Filters are not supported in APG TCL API V1.0 Software. All received port traffic is forwarded to the capture buffer.

3.6 PACKET CAPTURE

A 16KB capture buffer is available per port, that can be enabled using the **apgControlPort PORTCAPTURE** command. The contents of the capture buffer can be downloaded from the unit with **apgLoadPort CAPTURE**, and read with **apgGetPort CAPTURE PACKET**.

A single port can be enabled to capture to the 'deep' 1GB capture buffer, with the **apgControlPort DEEPCAPTURE** command.

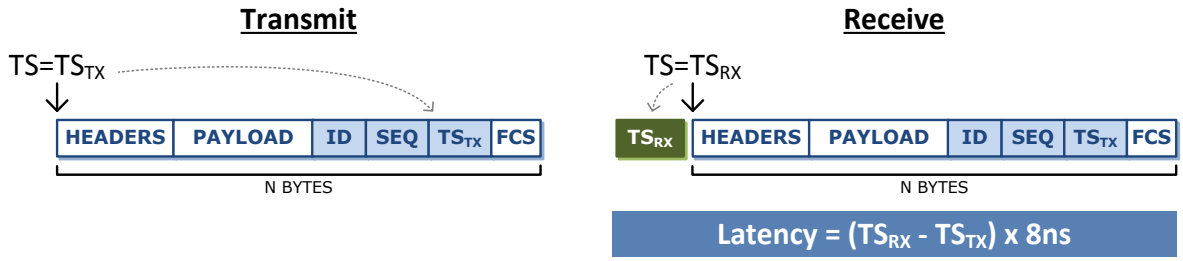
Packet capture is disabled with the **apgControlPort DISABLECAPTURE** command, and cleared with the **apgControlPort CLEARCAPTURE** command.

3.7 PACKET ANALYSIS

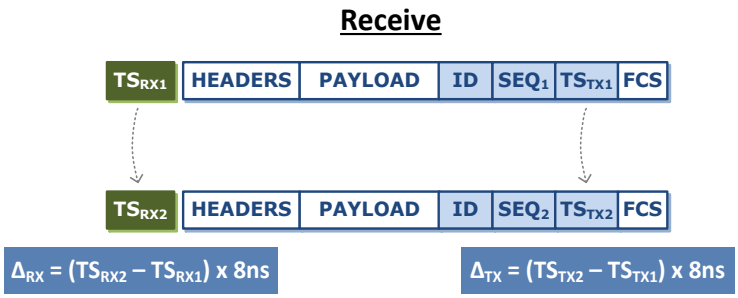
The Packet Analysis function provides basic analysis of the packet timestamp fields from the captured packets, and analysed with the **apgLoadPort ANALYSIS** command.

The 'Timestamp' fields are added to each transmitted packet of a timestamp-enabled stream. The transmit timestamp is the time of the first transmitted bit. The transmit sequence number increments for each packet transmitted from a **port**.

The Timing Analysis provides packet transmit-to-receive timing (latency):



Transmit-to-transmit timing (transmit stability) and receive-to-receive timing (receiver stability) are also performed:



The SEQUENCE numbers are checked for out-of-order packets, gaps and repeated values.

The analysis measurements are cleared using the **apgControlPort CLEARANALYSIS** command. Each time captured data is analysed with **apgLoadPort ANALYSIS**, the results are appended to the existing results.

The analysis results are read using **apgGetPort ANALYSIS**.

4. API INITIALISATION

The Axtrinet APG TCL API is initialised by sourcing the axtrinetApi.tcl file that contains:

- Path to the APG TCL API
- "package require" declaration
- Import APG TCL API Commands
- Header Definition file processing

4.1 INITIALISATION

4.1.1 Windows Environment

The APG TCL API is 'sourced' in the Windows environment with the following command:

```
# Instantiate APG TCL API
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"          ← Load API

# Display TCL Version Info
puts "[apgGetApiVersion DESCRIPTION] [apgGetApiVersion VERSION]"   → APG TCL API V1.0.0
puts "Build Date [apgGetApiVersion BUILD DATE]"                    → Build Date 1496403379
puts "Target API Version [apgGetApiVersion API_VERSION]"           → Target API Version 161016
```

4.1.2 Linux Environment

The APG TCL API is 'sourced' in the Linux environment with the following command:

```
# Instantiate APG TCL API
source "/usr/share/axtrinet/apg/axtrinetApi.tcl"                ← Load API

# Display TCL Version Info
puts "[apgGetApiVersion DESCRIPTION] [apgGetApiVersion VERSION]"   → APG TCL API V1.0.0
puts "Build Date [apgGetApiVersion BUILD DATE]"                    → Build Date 1496403379
puts "Target API Version [apgGetApiVersion API_VERSION]"           → Target API Version 161016
```

4.2 VERSION COMMAND - APGGETAPIVERSION

Get (read) the APG TCL API versions.

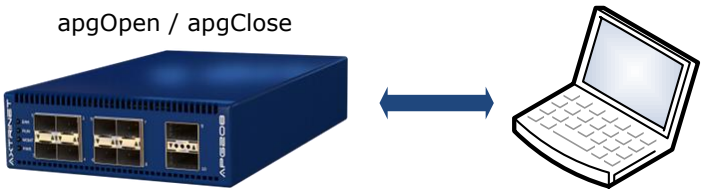
A **LOAD** command is not required before the **apgGetApiVersion**

4.2.1 apgGetApiVersion [VAR]

apgGetApiVersion returns the variable value if successful, otherwise the command will display an error message and exit the TCL environment.

[VAR]	LENGTH	DESCRIPTION	Example
COMPANY	21 char	Xentech Solutions Ltd	
BRAND	8 char	Axtrinet	
DESCRIPTION	11 char	APG TCL API	
VERSION	10 char	Axtrinet TCL API Version currently running	V1.0.0
BUILD_DATE	32 bits	Build date of the TCL API	1496403379
API_VERSION	6 char	Target API Version	161016

5. CONNECTION COMMANDS



Connection	**apgOpen [IP-ADDRESS]** **apgClose [UNITID]**

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"      ← Load API

# Open connection to unit at IP address 192.168.1.100
# Returns integer Unit ID
set IPADDRESS 192.168.1.100
set UNITID [apgOpen $IPADDRESS]                             → UNITID = 1
puts "Opened connection to Unit $UNITID at $IPADDRESS"

# Close connection
apgClose $UNITID                                            → 1
```

5.1 OPEN CONNECTION - APGOPEN

5.1.1 apgOpen [IP-ADDRESS]

Opens a connection to the Axtrinet Packet Generator at [IP-ADDRESS].

If the connection is successfully opened, **apgOpen** polls **apgLoadUnit STATUS** to determine the hardware status until the unit is READY (**apgLoadUnit STATUS READY** = 1).

apgOpen then loads the critical unit, port and stream information into the local databases using the following commands:

- **apgLoadUnit [UNITID] INFO**
- **apgLoadPort [PORTID] INFO**
- **apgLoadStream [STREAMID]**

If the connection is successfully opened and the critical configuration loaded from the unit, **apgOpen** returns the UNITID of the new unit.

If the connection fails to open, **apgOpen** exits the TCL environment. The connection may fail if two APG Control Interface or TCL management connections to the unit, the unit is being upgraded or the unit fails to boot (check front panel LEDs).

5.2 CLOSE CONNECTION - APGCLOSE

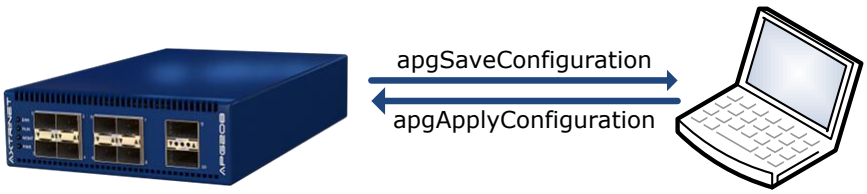
5.2.1 apgClose [UNITID]

Closes the connection to the Axtrinet Packet Generator UNITID.

apgClose returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

6. CONFIGURATION COMMANDS

The configuration commands **apgSaveConfiguration** and **apgApplyConfiguration** allow the unit configuration to be saved to and loaded from an external file.



Configuration **apgSaveConfiguration [UNITID] [PORTLIST] {FILENAME}**
apgApplyConfiguration [UNITID] [FILENAME]

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"          ← Load API

# Open connection to unit at IP address 192.168.1.100           Open Connection
# Returns integer Unit ID                                       → UNITID = 1
set IPADDRESS 192.168.1.100
set UNITID [apgOpen $IPADDRESS]
puts "Opened connection to Unit $UNITID at $IPADDRESS"

puts "Saving configuration"
set FILENAME APGexample.apg
apgSaveConfiguration $UNITID ALL $FILENAME                      Save Configuration

puts "Closing Connection"
apgClose $UNITID                                                Close Connection

################################

set UNITID [apgOpen $IPADDRESS]                                 Open Connection
puts "Opened connection to Unit $UNITID at $IPADDRESS"          → UNITID = 2

puts "Loading saved configuration $FILENAME"
apgApplyConfiguration $UNITID $FILENAME                         Load Configuration

puts "Closing Connection"
apgClose $UNITID                                                Close Connection
```

An example saved configuration file is shown in APPENDIX B - Sample apgSaveConfiguration File for port 1 only.

6.1 SAVE CONFIGURATION

6.1.1 apgSaveConfiguration [UNITID] [PORTLIST] {FILENAME}

Saves the unit UNITID PORTLIST port configuration to FILENAME.

PORTLIST can be "ALL" or in the list of PORTID format, eg `{{ 1 1 } { 1 3 }}`

If FILENAME is not specified, the default filename [SERIAL].config is used where SERIAL is **apgGetUnit [UNITID] INFO SERIAL**.

The saved configuration file contains the expected API_VERSION (**apgGetUnit [UNITID] INFO API_VERSION**) and PRODUCT (**apgGetUnit [UNITID] INFO PRODUCT**)

A 'cut down' example file is shown in Appendix B for a single port and stream. A saved file for the APG208 will contain the configuration for 10 ports each with 8 streams.

The saved configuration can be manually edited to modify the unit configuration.

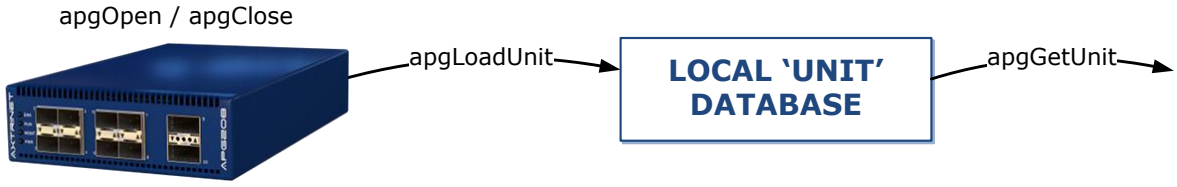
6.2 APPLY CONFIGURATION

6.2.1 apgApplyConfiguration [UNITID] [FILENAME]

Applies the stored configuration file FILENAME to unit UNITID.

File FILENAME is first scanned for suitability, verifying that the API_VERSION and PRODUCT type match. If there is an API_VERSION mismatch, the commands may not apply. If there is a PRODUCT mismatch, ports and stream configurations may not apply to the unit UNITID.

7. UNIT COMMANDS

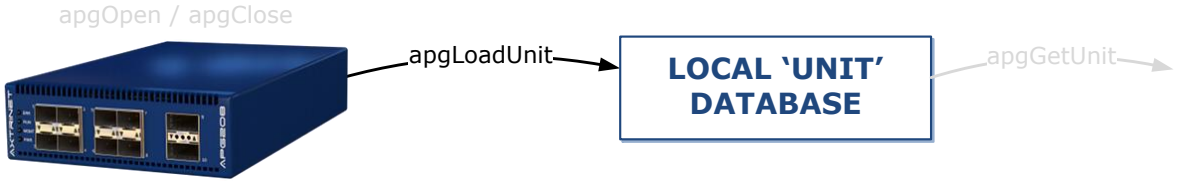


apgLoadUnit	**apgLoadUnit [UNITID] INFO** **apgLoadUnit [UNITID] STATUS**
	apgLoadUnit [UNITID] PORTSTATUS **apgLoadUnit [UNITID] COUNTERS** **apgLoadUnit [UNITID] RATES**
apgGetUnit	**apgGetUnit [UNITID] INFO [VAR]** **apgGetUnit [UNITID] STATUS [VAR]**

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"          ← Load API

# Open Connection
set IPADDRESS 192.168.1.100
set UNITID [apgOpen $IPADDRESS]

# Load unit information into local database
apgLoadUnit $UNITID INFO                                        → 1

# Get the unit information from the local database
set TYPE [apgGetUnit $UNITID INFO PRODUCT]                      → APG208
set SN   [apgGetUnit $UNITID INFO SERIAL]                       → APG000006

# Display unit information
puts "Unit $UNITID is an $TYPE with S/N $SN"

# Load unit status into local database
apgLoadUnit $UNITID STATUS                                      → 1

# Display unit status
set UPTIME [apgGetUnit $UNITID STATUS UPTIME]
puts "$SN has been on for [expr $UPTIME / 1000] secs"           → Eg 23000

set READY [apgGetUnit $UNITID STATUS READY]                     → 1
while !$READY {
    puts "Unit $UNITID is still booting"                        ~60sec after turned on
    after 5000
    set READY [apgGetUnit $UNITID STATUS READY]                 → 1
}

# Close connection
apgClose $UNITID                                                → 1
```

7.1 LOAD UNIT DATA - APGLOADUNIT



Load the UNIT configuration and status from the hardware into the local database.

apgLoadUnit returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

7.1.1 apgLoadUnit [UNITID] INFO

Loads the unit information into the local database, containing:

- Unit Product ID and Serial Number
- Hardware and Software Versions
- Port Count

The port information can be read using **apgGetUnit INFO**.

7.1.2 apgLoadUnit [UNITID] STATUS

Loads the unit status into the local database, containing:

- Uptime (ms)
- Temperature, Fan and Status Flags

The unit status can be read using **apgGetUnit STATUS**.

7.1.3 apgLoadUnit [UNITID] PORTSTATUS

Loads the unit port status into the local database, containing:

- Link Mode, Status and Speed
- Module Type
- Port Label

The port status can be read using **apgGetPort STATUS**.

7.1.4 apgLoadUnit [UNITID] COUNTERS

Loads the transmit and receive counters for all ports in the unit into the local database, containing:

- Time that the counter is read
- Number of Bytes
- Number of Good Packets
- Number of Underrun Packets
- Number of Packet Fragments
- Number of Packets with Frame Checksum (FCS) Errors
- Number of Frames with No Start-of-Frame Delimiter (SFD)
- Frame Rate (pps)

Port transmit counters can be read using **apgGetPort TXSTATS**.

Port receive counters can be read using **apgGetPort RXSTATS**.

7.1.5 apgLoadUnit [UNITID] RATES {DURATION}

The transmit and receive rates are calculated when **apgLoadUnit RATES** is called.

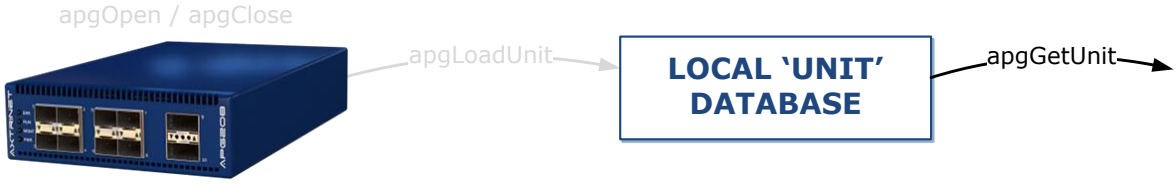
The rate calculator takes two counter readings, separated by {DURATION} milliseconds (eg 2000 = 2sec), to calculate the transmit and receive frame, byte, bit and error rates. If {DURATION} is omitted, a duration of 1000ms is assumed.

The transmit and receive rates are stored in the local database, containing:

- Transmit Frame, Byte and Bit Rates
- Receive Frame, Byte, Bit and Error Rates

Port rates can be read using **apgGetPort RATES**.

7.2 GET UNIT DATA - APGGETUNIT



Get (read) the UNIT configuration and status from the local database.

apgGetUnit returns the variable value if successful, otherwise the command will display an error message and exit the TCL environment.

7.2.1 apgGetUnit [UNITID] INFO [VAR]

The APG unit information can be read with the **apgGetUnit INFO** command.

The apgGetUnit INFO command must be preceded by at least one **apgLoadUnit INFO**, otherwise the command will display an error message and exit the TCL environment.

The unit INFO is static for the duration of the test session, and should only need to be read once at the start of the test.

[VAR]	LENGTH	DESCRIPTION
API_VERSION	32 bits	API Version of the Firmware eg 160229
PORT_COUNT	8 bits	Number of physical ports on the unit
API_MINIMUM	32 bits	Minimum API supported by the unit **[apgGetApiVersion API_VERSION]** must be greater than **API_MINUMUM**, and should ideally match.
SERIAL	16 chars	Serial Number eg APG000006
PRODUCT	12 chars	Product Code eg APG208
FW_VERSION	8 chars	Firmware Version loaded onto the UNIT eg 1.2-1
FW_BUILDDATE	32 bits	Build timestamp of the Firmware Version loaded onto the UNIT eg 1457534868
FPGA_VERSION	8 chars	Firmware Version loaded onto the UNIT eg 1.652
FPGA_BUILDDATE	32 bits	Build timestamp of the Firmware Version loaded onto the UNIT eg 1455890890
HW_VERSION	8 chars	Hardware Version of the Unit eg A.00.00

7.2.2 apgGetUnit [UNITID] STATUS [VAR]

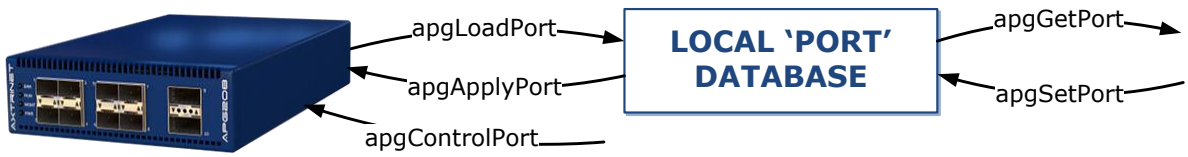
The APG unit status can be read with the **apgGetUnit STATUS** command.

The **apgGetUnit STATUS** command must be preceded by at least one **apgLoadUnit STATUS**, otherwise the command will display an error message and exit the TCL environment.

The unit STATUS is dynamic, and should be re-loaded before reading.

[VAR]	LENGTH	DESCRIPTION
UPTIME	64 bits	Time since the unit was powered up (in ms)
TEMP	2 bits	Temperature Flags, calculated from the preset $T_{OPERATE}$, $T_{WARNING}$ and $T_{SHUTDOWN}$ temperature thresholds: 0 = OK $T \leq T_{OPERATE} + 3$ 1 = HIGH $T_{OPERATE} + 3 \leq T < T_{WARNING}$ 2 = WARNING $T_{WARNING} \leq T < T_{SHUTDOWN}$ 3 = ALARM $T > T_{WARN}$
FAN	1 bit	0 = Fan Failed 1 = Fan OK
SELFTEST	1 bit	0 = Self-Test Failed 1 = Self-Test Passed Self-Test verifies that the internal power supplies are within tolerance and that the CPU interfaces are operational.
READY	1 bit	0 = Unit not ready (FPGA Booting) 1 = Unit Ready (FPGA Booted)

8. PORT COMMANDS



apgLoadPort	**apgLoadPort [PORTID] INFO** **apgLoadPort [PORTID] MODULE** **apgLoadPort [PORTID] CAPTURE** **apgLoadPort [PORTID] ANALYSIS {TSID}**
apgGetPort	**apgGetPort [PORTID] INFO [VAR]** **apgGetPort [PORTID] STATUS [VAR]** **apgGetPort [PORTID] MODULE [VAR]** **apgGetPort [PORTID] TXSTATS [VAR]** **apgGetPort [PORTID] RXSTATS [VAR]** **apgGetPort [PORTID] RATES [VAR]** **apgGetPort [PORTID] CAPTURE CONFIG [VAR]** **apgGetPort [PORTID] CAPTURE PACKET TOTALPACKETS** **apgGetPort [PORTID] CAPTURE PACKET [VAR] [PKTNUM]** **apgGetPort [PORTID] ANALYSIS [TYPE] [VAR]**
apgSetPort	**apgSetPort [PORTID] [VAR] [VAL]**
apgApplyPort	**apgApplyPort [PORTID]**
apgControlPort	**apgControlPort [COMMAND] [PORTLIST]** **apgControlPort [CAPTURE] [PORTLIST]**

Where PORTID = {UNIT.PORT} or {UNIT.PORT.SUBPORT}

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"                    ← Load API

# Open Connection                                                         Open
set IPADDRESS $::DutIpAddress                                             Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST ""

# Generate Port List                                                      Generate Port
puts "\nDEMO: Generating Port List for Unit $UNITID"                      list
apgLoadUnit $UNITID INFO
set PORT_COUNT [apgGetUnit $UNITID INFO PORT_COUNT]
for { set PO 1 } { $PO <= $PORT_COUNT } { incr PO } {                     All ports
  set PORTID [list $UNITID $PO]
  apgLoadPort $PORTID INFO
  set NSUBPORTS [apgGetPort $PORTID INFO NSUBPORTS]
  for { set SP 0 } { $SP <= $NSUBPORTS } { incr SP } {                    All subports
    set SUBPORTID [list $UNITID $PO $SP]
    if { $SP > 0 } { apgLoadPort $SUBPORTID INFO }
    if { [apgGetPort $SUBPORTID INFO NSUBPORTS] == 0 } {
      lappend PORTLIST $SUBPORTID
    }
  }
}
puts "      -> $PORTLIST"

# Configure Streams                                                       Configure
puts "\nDEMO: Configure Streams"                                          Streams
set STREAM 0
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  puts "      -> Port $PO"
```

```
  for { set ST 0 } { $ST < 8 } { incr ST } {
    set STREAMID [linsert $PORTID end $ST]
    if { $ST == 0 } {                                                    Stream 0
      apgSetStream $STREAMID DEFAULT
      apgSetStream $STREAMID CONFIG ENABLE 1                             Enable
      apgSetStream $STREAMID CONFIG SIZE_MODE RANDOM                     Random Size
      apgSetStream $STREAMID CONFIG PACKET_SIZE 64                       64 -
      apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 5000                  5000 bytes
      apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER"              MACHEADER
      apgSetStream $STREAMID HEADER MACHEADER DA \
        [format "08:%02d:%02d:%02d:%02d:00" $UN $PO $SP $ST]
      apgSetStream $STREAMID HEADER MACHEADER SA \
        [format "08:%02d:%02d:%02d:%02d:01" $UN $PO $SP $ST]
      apgSetStream $STREAMID PAYLOAD DATA_CONTROL RANDOM                 Random Data
      if { $PO >= 9 } {                                                  If 40G
        apgSetStream $STREAMID PAYLOAD DATA_CONTROL INCREMENT             Increment
        apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "01 02 03 04 05 06 07 08"   Data
      }
    } else {
      apgSetStream $STREAMID CONFIG ENABLE 0                             Disable 1-7
    }
    apgApplyStream $STREAMID                                             Apply Config
  }
}
```

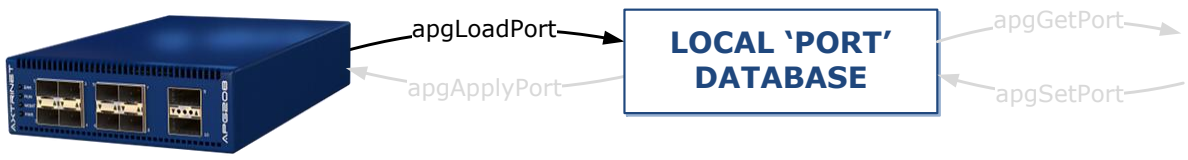
```
# Port Transmit & Capture Control                                        TX Control
puts "\nDEMO: Generating Packets for 3 seconds"
apgControlPort STOPTX $PORTLIST
apgControlPort CLEARCOUNTERS $PORTLIST                                   Clear counts
apgControlPort STARTTX $PORTLIST                                         Start TX
after 1000
puts "DEMO: Calculating data rates over 1000ms"                          Calculate
apgLoadUnit $UNITID RATES 1000                                           Rates
puts "DEMO: Clearing Capture Buffers and enabling Capture on all ports "
apgControlPort PORTCAPTURE $PORTLIST
after 1000                                                               Enable Capture
puts "DEMO: Stopping Traffic"
apgControlPort STOPTX $PORTLIST                                          Stop TX
```

```
# Port Counters                                                          Counters
puts "\nDEMO: Display Port Counters"
apgLoadUnit $UNITID COUNTERS                                             Load
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  set TXPKT  [apgGetPort $PORTID TXSTATS GOOD_PACKETS]                   Get counters
  set TXRATE [expr [apgGetPort $PORTID RATES TXBITRATE] / 1000000.0]
  set RXPKT  [apgGetPort $PORTID RXSTATS GOOD_PACKETS]
  if { $TXPKT > 0 } {
    puts [format "      Port %2d TX %7d at %8.2f Mbps, RX %7d packets" \
      $PO $TXPKT $TXRATE $RXPKT]
  }
}
```

```
# Port Capture                                                           Capture
puts "\nDEMO: Display Captured Packets"
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  apgLoadPort $PORTID CAPTURE CONFIG                                     Load config
  set AVAILABLE [apgGetPort $PORTID CAPTURE CONFIG AVAILABLE ]
  if { $AVAILABLE > 0 } {                                                If data ...
    apgLoadPort $PORTID CAPTURE BUFFER                                   Load buffer
    puts "\n      Port $PO:\n"
    set PKTCOUNT [ apgGetPort $PORTID CAPTURE PACKET TOTALPACKETS ]
    for { set PKT 1 } { $PKT <= $PKTCOUNT } { incr PKT } {
      set LENGTH [apgGetPort $PORTID CAPTURE PACKET LENGTH $PKT]          Display data
      puts -nonewline [format "      %3d: %5d bytes -> " $PKT $LENGTH]
      set DATA [apgGetPort $PORTID CAPTURE PACKET DATA $PKT]
      foreach BYTE $DATA { puts -nonewline [format "%02X " $BYTE] }
      puts ""
    }
  }
}
```

```
# Close connection                                                       Close
apgClose $UNITID                                                         connection
```

8.1 LOAD PORT DATA - APGLOADPORT



Loads the PORT configuration and status from the hardware into the local database.

apgLoadPort returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

8.1.1 apgLoadPort [PORTID] INFO

Loads the port information into the local database, containing:

- Port Topology (eg 40Gbps or 4x10Gbps)
- Impact of Topology Change flags
- Number of Subports (eg 1 for 10Gbps Ports, 4 for 40Gbps Ports)
- Maximum Number of Streams (8)
- Maximum Number of Filters (4)

The port information can be read using **apgGetPort INFO**.

8.1.2 apgLoadPort [PORTID] MODULE

Loads the module information into the local port database.

Only the ID, VENDOR and DIAGNOSTIC information is available.

The port information can be read using **apgGetPort MODULE**.

8.1.3 apgLoadPort [PORTID] CAPTURE [VAR] {NUMPKT}

Loads the contents of the port capture configuration or buffer into the local port database.

[VAR]	DESCRIPTION
CONFIG	Load the port capture configuration into the local port database.
BUFFER	Load the port capture buffer into the local port database {NUMPKT} is an optional field to define the number of packets to be downloaded from the unit, starting from the first captured packet. If {NUMPKT} is not declared, **all** captured packets are downloaded from the unit.

The port information can be read using **apgGetPort CAPTURE**.

apgLoadPort CAPTURE BUFFER takes ~1secs to download and process a full 10Gbps port capture, and ~3sec to download and process a full 40Gbps port capture.

A full 66MB DEEP CAPTURE buffer will take ~12min to download

8.1.4 apgLoadPort [PORTID] ANALYSIS {TSID}

The port analysis calculations are performed when **apgLoadPort ANALYSIS** is called.

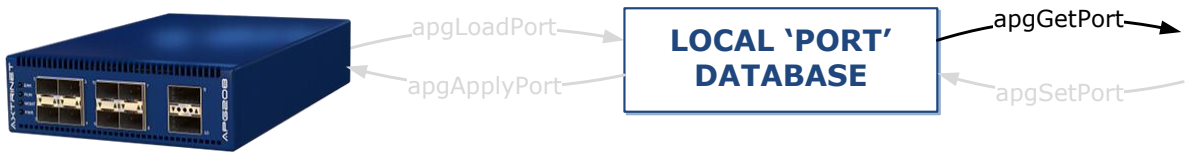
The analysis calculations are performed on **captured** data. The **apgLoadPort CAPTURE BUFFER** command enables capture on the port, and captures until the capture buffer is full. The captured data is then downloaded and processed automatically. Only packets that match the timestamp identifier **TSID** are processed. The **TIMESTAMPID** field is ignored if no **TSID** value is set.

The latency measurements are stored in the local database, containing:

- Transmit-to-transmit timing measurements
- Transmit-to-receive timing measurements
- Receive-to-receive timing measurements

Packet latency measurements can be read using **apgGetPort ANALYSIS**.

8.2 GET PORT DATA - APGGETPORT



apgGetPort returns the variable value if successful, otherwise the command will display an error message and exit the TCL environment.

8.2.1 apgGetPort [PORTID] INFO [VAR]

The port information can be read using the **apgGetPort INFO** command.

The **apgGetPort INFO** command must be preceded by at least one **apgLoadPort INFO**, otherwise the command will display an error message and exit the TCL environment.

Port information is relatively static during a test and should only need to be read once at the start of the test, or if the port transceiver or topology is changed.

[VAR]	LENGTH	DESCRIPTION
TOPOLOGY	16 bits	Current port topology: Bit 0-7 = Reserved Bit 8 = Blocked (0x0100) Bit 9 = 1Gbps (0x0200) Bit 10 = Reserved Bit 11 = 10Gbps (0x0800) Bit 12 = 4x10Gbps (0x1000) Bit 13 = 40Gbps (0x2000) Bit 14-15 = Reserved

[VAR]	LENGTH	DESCRIPTION
TOPOLOGY_CAP	16 bits	Port topology capabilities: Bit 0-7 = Reserved Bit 8 = Blocked (0x0100) Bit 9 = 1Gbps (0x0200) Bit 10 = Reserved Bit 11 = 10Gbps (0x0800) Bit 12 = 4x10Gbps (0x1000) Bit 13 = 40Gbps (0x2000) Bit 14-15 = Reserved
NSUBPORTS	8 bits	Number of subports associated with the port
NSTREAMS	8 bits	Maximum number of streams that can be configured on the port
NFILTERS	8 bits	Maximum number of filters that can be configured on the port

8.2.2 apgGetPort [PORTID] STATUS [VAR]

The port status can be read using the **apgGetPort STATUS** command.

The **apgGetPort STATUS** must always be preceded by at least one **apgLoadUnit PORTSTATUS**, otherwise the command will display an error message and exit the TCL environment.

The **apgGetPort STATUS** is dynamic during a test as the link status changes, and should always be preceded by **apgLoadUnit PORTSTATUS**

[VAR]	LENGTH	DESCRIPTION
LINK	8 bits	0 = No Link 1 = Link OK
MODULE_STATUS	8 bits	Bit 0 = Not Present Bit 1 = Module Present Bit 2 = Module Fault Bit 3 = LOS Bit 4 = Transmit Enable Bit 5 = Rate Select 0 Bit 6 = Rate Select 1 Bit 7 = Reserved
SPEED	16 bits	Bit 0 = 10Mbps Bit 1 = 100Mbps Bit 2 = 1Gbps Bit 3 = 10Gbps Bit 4 = 40Gbps Bit 5 = 100Gbps Bit 6 = 4x10Gbps Bit 7-15 = Reserved Note that SPEED returns the expected port speed if the link is down, and the actual port speed if the link is up.
SPEED_ABILITY	16 bits	Bit 0 = 10Mbps Bit 1 = 100Mbps Bit 2 = 1Gbps Bit 3 = 10Gbps Bit 4 = 40Gbps Bit 5 = 100Gbps Bit 6 = 4x10Gbps Bit 7-15 = Reserved
MODULE_SEQUENCE	16 bits	Module Sequence ID → Number of times a module has been inserted. Used to determine whether the module has changed.
MODULE_TYPE	8 bits	0 = No Module 1 = SFP/SFP+ 2 = QSFP+
MODULE_CLASS	8 bits	0 = None 1 = Fibre 2 = Copper 3 = Passive Direct Attach 4 = Active Direct Attach
MODULE_TEMP	16 bits	Module Temperature (°C) Measured in 1/256ths of a degree. (ie divide by 256 to get measured temperature)

[VAR]	LENGTH	DESCRIPTION
LINKMODE	8 bits	Current MAC-to-Module PMA Link Mode: Bit 0 = 1000Base-X (SFP+ Port only) Bit 1 = SGMII (SFP+ Port only) Bits 3-4 = Reserved Bit 5 = SRLR (QSFP+ only) Note that the unit software will automatically choose the preferred link mode based on the transceiver, but can be over-written by the user.
LINKMODE_CAP	8 bits	MAC-to-Module PMA Link Mode Capabilities: Bit 0 = 1000Base-X (SFP+ Port only) Bit 1 = SGMII (SFP+ Port only) Bits 3-4 = Reserved Bit 5 = SRLR (QSFP+ only)
TIMESTAMPID	32 bits	Timestamp ID field
PORTNAME	12 char	Port Name

8.2.3 apgGetPort [PORTID] MODULE [VAR]

The module information can be read using the **apgGetPort MODULE** command.

The **apgGetPort MODULE** must always be preceded by at least one **apgLoadPort MODULE**, otherwise the command will display an error message and exit the TCL environment.

The **apgGetPort MODULE** is dynamic during a test as the link status changes, and should always be preceded by **apgLoadPort MODULE**.

[VAR]	LENGTH	DESCRIPTION
MODULE_TYPE	8 bits	0 = No Module 1 = SFP/SFP+ 2 = QSFP+
ID	96 chars	Serial ID Fields
VENDOR_ID	32 chars	Vendor-Specific ID field

The following fields are extracted from the ID Fields:

[VAR]	LENGTH	DESCRIPTION
VENDOR_NAME	16 char	Manufacturer
VENDOR_PN	16 char	Manufacturer's Part Number
VENDOR_REV	4 char	Manufacturer's Revision
VENDOR_SN	16 char	Manufacturer's Serial Number
DATECODE	64 bits	Manufacturing Date

8.2.4 apgGetPort [PORTID] TXSTATS [VAR]

The transmit counters are read with the **apgGetPort TXSTATS** command.

The **apgGetPort TXSTATS** must always be preceded by at least one **apgLoadUnit COUNTERS**, otherwise the command will display an error message and exit the TCL environment.

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"
```

```
# Open Connection                                          Open
set IPADDRESS 192.168.1.100                                Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST {{$UNITID 1 0} {$UNITID 2 0}}
```

```
# Port Counters                                            Counters
puts "\nDEMO: Display Port Counters"
apgLoadUnit $UNITID COUNTERS                               Load
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  set TXPKT  [apgGetPort $PORTID TXSTATS GOOD_PACKETS]     Get counters
  set TXRATE [expr [apgGetPort $PORTID RATES TXBITRATE] / 1000000.0]
  set RXPKT  [apgGetPort $PORTID RXSTATS GOOD_PACKETS]
  if { $TXPKT > 0 } {
    puts [format "      Port %2d TX %7d at %8.2f Mbps, RX %7d packets" \
      $PO $TXPKT $TXRATE $RXPKT]
  }
}
```

```
# Close connection                                         Close
apgClose $UNITID                                           connection
```

The **apgGetPort TXSTATS** will change during a test, and should always be preceded by a **apgLoadUnit COUNTERS** command. If the counters are not re-loaded, **apgGetPort TXSTATS** will return the previous values.

[VAR]	LENGTH	DESCRIPTION
TIMESTAMP	32 bits	Time that the transmit counters are read
BYTES	64 bits	Number of transmitted bytes
GOOD_PACKETS	64 bits	Number of good packets transmitted
PKT_64	32 bits	Count of 64 byte packets transmitted
PKT_65_128	32 bits	Count of 65-128 byte packets transmitted
PKT_129_256	32 bits	Count of 129-256 byte packets transmitted
PKT_257_512	32 bits	Count of 257-512 byte packets transmitted
PKT_513_1024	32 bits	Count of 513-1024 byte packets transmitted
PKT_1025_1536	32 bits	Count of 1025-1536 byte packets transmitted
PKT_1537_9000	32 bits	Count of 1537-9000 byte packets transmitted
PKT_9001_MAX	32 bits	Count of >9001 byte packets transmitted
TX_RUNTIME	32 bits	Time in seconds since the transmit command was sent

8.2.5 apgGetPort [PORTID] RXSTATS [VAR]

The receive counters are read with the **apgGetPort RXSTATS** command.

The **apgGetPort RXSTATS** must always be preceded by at least one **apgLoadUnit COUNTERS**, otherwise the command will display an error message and exit the TCL environment.

The **apgGetPort RXSTATS** will change during a test, and should always be preceded by a **apgLoadUnit COUNTERS** command. If the counters are not re-loaded, **apgGetPort RXSTATS** will return the previous values.

[VAR]	LENGTH	DESCRIPTION
TIMESTAMP	32 bits	Time that the receive counters are read
BYTES	64 bits	Number of received bytes
GOOD_PACKETS	64 bits	Number of good packets received
PKT_UNDERSIZE	32 bits	Number of under-sized (<64 Bytes) packets received
PKT_FRAGMENTS	32 bits	Number of packets fragments received
PKT_FCSERROR	32 bits	Number of packets received with Frame Checksum (FCS) Errors
PKT_NOSFD	32 bits	Number of packets received without a valid Start-of-Frame Delimiter (SFD)
PKT_64	32 bits	Count of 64 byte packets received
PKT_65_128	32 bits	Count of 65-128 byte packets received
PKT_129_256	32 bits	Count of 129-256 byte packets received
PKT_257_512	32 bits	Count of 257-512 byte packets received
PKT_513_1024	32 bits	Count of 513-1024 byte packets received
PKT_1025_1536	32 bits	Count of 1025-1536 byte packets received
PKT_1537_9000	32 bits	Count of 1537-9000 byte packets received
PKT_9001_MAX	32 bits	Count of >9001 byte packets received
FILTER1	32 bits	Packets matched by Filter 1
FILTER2	32 bits	Packets matched by Filter 2
FILTER3	32 bits	Packets matched by Filter 3
FILTER4	32 bits	Packets matched by Filter 4

8.2.6 apgGetPort [PORTID] RATES [VAR]

The transmit and receive data rates are read with the **apgGetPort RATES** command.

apgGetPort RATES must always be preceded by at least one **apgLoadUnit RATES**, otherwise the command will display an error message and exit the TCL environment.

apgGetPort RATES will change during a test, and should always be preceded by a **apgLoadUnit RATES** command. If the rates are not re-loaded, **apgGetPort RATES** will return the previous values.

[VAR]	LENGTH	DESCRIPTION
TXPKTRATE	32 bits	Transmit Packet Rate (packets/sec)
TXBYTERATE	64 bits	Transmit Byte Rate (Bytes/sec) Derived from the Transmit BYTE count
TXBITRATE	64 bits	Transmit Bit Rate (Bits/sec) Bits on the wire, including Inter-Frame Gap (IFG) and Start-of-Frame (SFD) delimiter.
RXPKTRATE	32 bits	Receive Packet Rate (packets/sec)
RXERRORRATE	32 bits	Receive FCS Errored Packet Rate (packets/sec). Divide the returned value by 16384 to get the FCS errored packets per second.
RXBYTERATE	64 bits	Receive Byte Rate (Bytes/sec) Derived from the Receive BYTE count
RXBITRATE	64 bits	Receive Bit Rate (Bits/sec) Bits on the wire, including Inter-Frame Gap (IFG) and Start-of-Frame (SFD) delimiter.

8.2.7 apgGetPort [PORTID] CAPTURE CONFIG [VAR]

Read the capture configuration, buffer and available memory sizes.

apgGetPort CAPTURE CONFIG must always be preceded by at least one **apgLoadPort CAPTURE CONFIG**, otherwise the command will display an error message and exit the TCL environment.

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"
```

```
# Open Connection                                                    Open
set IPADDRESS 192.168.1.100                                          Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST {{$UNITID 1 0} {$UNITID 2 0}}
```

```
# Capture Control                                                    TX Control
puts "\nDEMO: Generating Packets"
apgControlPort STOPTX $PORTLIST
apgControlPort STARTTX $PORTLIST                                     Start TX
puts "DEMO: Clearing Capture Buffers and enabling Capture on all ports "
apgControlPort PORTCAPTURE $PORTLIST                                 Enable
after 100                                                            Capture
puts "DEMO: Stopping Traffic"
apgControlPort STOPTX $PORTLIST                                      Stop TX
```

```
# Port Capture                                                       Capture
puts "\nDEMO: Display Captured Packets"
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  apgLoadPort $PORTID CAPTURE CONFIG                                 Load config
  set AVAILABLE [apgGetPort $PORTID CAPTURE CONFIG AVAILABLE ]
  if { $AVAILABLE > 0 } {                                            If data ...
    apgLoadPort $PORTID CAPTURE BUFFER                               Load buffer
    puts "\n      Port $PO:\n"
    set PKTCOUNT [ apgGetPort $PORTID CAPTURE PACKET TOTALPACKETS ]
    for { set PKT 1 } { $PKT <= $PKTCOUNT } { incr PKT } {
      set LENGTH [apgGetPort $PORTID CAPTURE PACKET LENGTH $PKT]      Display data
      puts -nonewline [format "      %3d: %5d bytes -> " $PKT $LENGTH]
      set DATA [apgGetPort $PORTID CAPTURE PACKET DATA $PKT]
      foreach BYTE $DATA { puts -nonewline [format "%02X " $BYTE] }
      puts ""
    }
  }
}
```

```
# Close connection                                                   Close
apgClose $UNITID                                                     connection
```

apgGetPort CAPTURE CONFIG will change while the capture buffer is filling, and should always be preceded by a **apgLoadPort CAPTURE CONFIG** command.

[VAR]	LENGTH	DESCRIPTION
AVAILABLE	32 bits	Filled capture data available for upload (bytes)
BUFFERSIZE	32 bits	Total memory available for packet capture (bytes)
FLAGS	2 bits	0 = Capture Disabled 1 = 16KB Port Buffer Enabled & Capturing Packets 2 = Capture Disabled 3 = 1GB Extended Packet Buffer Enabled & Capturing Packets  The FLAGS are set indirectly using the **apgControlPort [CAPTURE]** commands

Packet capture is controlled with the **apgControlPort PORTCAPTURE**, **apgControlPort DISABLECAPTURE**, **apgControlPort CLEARCAPTURE** commands to start, stop and clear the capture buffer.

The capture buffer is loaded using **apgLoadPort CAPTURE BUFFER**, and read using **apgGetPort CAPTURE PACKET**.

8.2.8 apgGetPort [PORTID] CAPTURE PACKET TOTALPACKETS

TOTALPACKETS (32 bits) is the total number of packets held in the capture buffer.

The capture configuration is loaded with **apgLoadPort [PORTID] CAPTURE BUFFER**.

8.2.9 apgGetPort [PORTID] CAPTURE PACKET [VAR] [PKTNUM]

Read the capture packet data, where [PKTNUM] is the packet number in the capture buffer in the range 1 to [TOTALPACKETS].

The capture configuration is loaded with **apgLoadPort [PORTID] CAPTURE BUFFER**.

[VAR]	LENGTH	DESCRIPTION
RXTIME	64 bits	Receive timestamp of packet [PKTNUM] measured in 8ns intervals since the unit was turned on.
TSMODE	4 bits	Receive Timestamp Flag of packet [PKTNUM] 0xA = Approximated timestamp Anything else = Actual timestamp.
LENGTH	16 bits	Length of packet [PKTNUM]
PKTERROR	1 bit	Packet Error Flag of packet [PKTNUM]: 0 = OK 1 = FCS Error
DATA	[String]	Captured data of packet [PKTNUM] Packet format is space-separated integers

The following variables are also valid if the **TIMESTAMP_CONTROL** is enabled (see Section 9.2.4) the **transmitting** stream:

[VAR]	LENGTH	DESCRIPTION
IDFIELD	32 bits	ID Field extracted from packet [PKTNUM] Bytes [LENGTH]-19 to [LENGTH]-16
SEQNUM	32 bits	Sequence Number extracted from packet [PKTNUM] Bytes [LENGTH]-15 to [LENGTH]-12
TXTIME	64 bits	Transmit timestamp extracted from packet [PKTNUM] Bytes [LENGTH]-11 to [LENGTH]-4, measured in 8ns intervals since the unit was turned on.
DELTA	32 bits	Latency of packet [PKTNUM], calculated by [TSRX]–[TSTX] measured in 8ns ticks.

WARNING: ID, SEQ and TXTIME field are extracted on every captured packet, regardless of the validity of the received packet. Care must be taken to ensure that the receive packets contain the expected data before further processing the information.

Packet capture is enabled with **apgControlPort PORTCAPTURE** command.

The amount of data available for download can be monitored using the **apgLoadPort CAPTURE BUFFER** and **apgGetPort CAPTURE PACKET TOTALPACKETS** to get the total number of captured packets.

8.2.10 apgGetPort [PORTID] ANALYSIS [TYPE] [VAR]

The latency measurements are read with the **apgGetPort ANALYSIS** command.

apgGetPort ANALYSIS must always be preceded by at least one **apgLoadPort ANALYSIS**, otherwise the command will display an error message and exit the TCL environment.

If the measurements are not re-calculated, **apgGetPort ANALYSIS** will return the previous values.

[TYPE]	DESCRIPTION
TXTX	Transmit-to-transmit timestamp calculations
TXRX	Transmit-to-receive timestamp calculations
RXRX	Receive-to-receive timestamp calculations
SEQUENCE	Sequence Number status

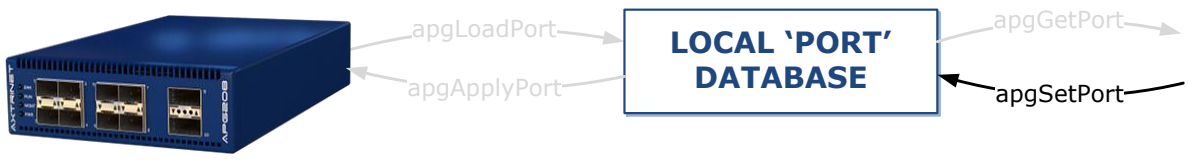
If **[TYPE]** is **TXRX, TXTX** or **RXRX**, the following **[VAR]** are available:

[VAR]	DESCRIPTION
CYCLES	Number of capture cycles to collect samples
SAMPLES	Number of processed latency samples
LIST	List of processed timing deltas
MIN	Minimum latency, measured in 8ns ticks
MAX	Maximum latency, measured in 8ns ticks
MEAN	Mean latency, measured in 8ns ticks
MODE	Mode latency, measured in 8ns ticks
STDDEV	Standard Deviation, measured in 8ns ticks

If **[TYPE]** is **SEQUENCE**, the following **[VAR]** are available:

[VAR]	DESCRIPTION
CYCLES	Number of capture cycles to collect samples
SAMPLES	Number of processed SEQ samples
LIST	List of processed SEQ samples
MIN	Minimum SEQNUM from sample
MAX	Maximum SEQNUM from sample
RANGE	SEQNUM range from sample
MONOTONIC	1=Monotonic 0=Not Monotonic
RPTCOUNT	Repeated Counter, increments if SEQ_n has been seen before
GAPCOUNT	Gap Counter, increments if $SEQ_n > SEQ_{n-1} + 1$
OOOCOUNT	Out-of-Order Counter, increments if $SEQ_n < SEQ_{max}$

8.3 SET PORT CONFIGURATION - APGSETPORT



apgSetPort returns the set value if successful, otherwise the command will display an error message and exit the TCL environment.

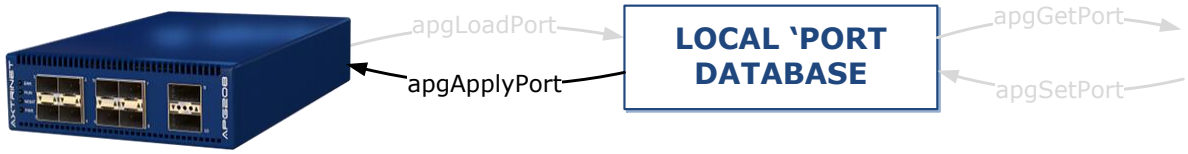
8.3.1 apgSetPort [PORTID] [VAR] [VAL]

The **apgSetPort** command allows configuration of the transceiver inserted into the port, and **must** be followed with **apgApplyPort STATE** to apply the port configuration onto the unit.

The [VAR] and [VAL] fields can be:

[VAR]	Description	Default
TXENABLE	0 = Module Disabled 1 = Module Enabled	0x1
RATE	[RATE SELECT 1][RATE SELECT 0] 0 = RS1 & RS0 Not Set (low speed operation) 1 = RS1 Not Set, RS0 Set 2 = RS1 Set, RS0 Not Set 3 = RS1 & RS0 Set (high speed operation) Note: Both bits should normally be set high for 10Gbps operation, although some vendor's transceivers do not meet the SFP MSA guidelines. Check vendor's recommended settings in the datasheet.	0x3
TOPOLOGY	BLOCKED = Port Disabled **SFP+ Ports only:** 1G = Fixed 1Gbps 10G = Fixed 10Gbps **QSFP+ Ports only:** 40G = Fixed 40Gbps 4x10G = Fixed 4x10Gbps	 SFP+ Ports: 10G QSFP+ Ports: 40G
LINKMODE	**SFP+ Ports only:** 1000X = 1000Base-X (1Gbps only) SGMII = SGMII (10Gbps or 1Gbps) **QSFP+ Ports only:** SRLR = 40GBase-SR/LR	SFP+ Ports: SGMII QSFP+ Ports: SRLR

8.4 APPLY PORT CONFIGURATION - APGAPPLYPORT



apgApplyPort returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

8.4.1 apgApplyPort [PORTID] STATE

The **apgApplyPort STATE** command must be used after **apgSetPort** command to apply the configuration changes to the unit.

8.5 CONTROL COMMANDS - APGCONTROLPORT

Packet generation and capture are controlled with the **apgControlPort** command.

apgControlPort returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

A port can be one of four transmit states:

STATE	Description
STOPPED	Traffic generation stopped. Stream configuration is loaded into the port traffic generator when a **STARTTX** or **STEPTX** is issued. Port transmit counters are stopped, although the port receive counters may still be counting if the port is receiving traffic.
TRANSMITTING	The port is generating traffic, and remains in this state until a **STOPTX**, **PAUSETX** or **STEPTX** command is issued. If all of the enabled streams are generating fixed burst length traffic, the port will stop transmitting when all streams have transmitted the **BURST LENGTH** number of packets and move to the **STOPPED** state. A **STEPTX** command transmits the next packet, then PAUSES. Issuing a second **STARTTX** has no effect.
PAUSED	Traffic generation is stopped. Transmission continues when a **STARTTX** or **STEPTX** command is issued, without loading a new stream configuration. The PAUSE state is useful for interrupting a continuous stream to allow the test data to settle and read the counters.
STEP	Transmit the next packet from the stream queue. The port immediately returns to the PAUSED state.

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"                    ← Load API

# Open Connection                                                         Open
set IPADDRESS 192.168.1.100                                               Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST {{$UNITID 1 0} {$UNITID 2 0}}

# Port Transmit & Capture Control                                         TX Control
puts "\nDEMO: Generating Packets for 3 seconds"
apgControlPort STOPTX $PORTLIST
apgControlPort CLEARCOUNTERS $PORTLIST                                    Clear counts
apgControlPort STARTTX $PORTLIST                                          Start TX
after 1000
puts "DEMO: Calculating data rates over 1000ms"                           Calc Rates
apgLoadUnit $UNITID RATES 1000
puts "DEMO: Clearing Capture Buffers and enabling Capture on all ports "
apgControlPort PORTCAPTURE $PORTLIST                                      Enable
after 1000                                                                Capture
puts "DEMO: Stopping Traffic"
apgControlPort STOPTX $PORTLIST                                           Stop TX

# Close connection                                                        Close
apgClose $UNITID                                                          connection
```

8.5.1 apgControlPort [COMMAND] [PORTLIST]

Traffic generator control is performed on a group of ports identified by [PORTLIST].

[PORTLIST] is a TCL list of PORTIDs:

Eg: `apgControlPort STARTTX {{ 1 1 } { 1 3 }}` Starts transmission on ports 1 & 3

The following control commands can be used to control the port traffic generator:

[COMMAND]	Description
STARTTX	Start packet transmission on all [PORTLIST] ports. From the STOPPED state, **STARTTX** loads the new stream configuration on all [PORTLIST] ports and start transmitting. From the PAUSED state, packet transmission will start without loading the latest configuration.
STEPTX	Transmit the next packet on all [PORTLIST] ports. From the STOPPED state, **STEPTX** loads the new stream configuration on all [PORTLIST] ports and transmits a single packet. Where multiple streams are enabled, the port will transmit the next packet from the stream sequencer.
PAUSETX	Pause the packet transmission on all [PORTLIST] ports
STOPTX	Stop the packet transmission on all [PORTLIST] ports
CLEARCOUNTERS	Clear the transmit and receive packet counters on all [PORTLIST] ports

8.5.2 apgControlPort [CAPTURE] [PORTLIST]

Capture control is performed on a group of ports identified by [PORTLIST].

The following control commands can be used to control the port packet capture:

[CAPTURE]	Description
PORTCAPTURE	Enable the 16KB capture buffers on all [PORTLIST] ports and start capturing packets.
DEEPCAPTURE	Enable the 1GB extended capture buffer on all [PORTLIST] ports and start capturing packets.
DISABLECAPTURE	Disable capturing on all [PORTLIST] ports  Capture **must** be enabled to read the capture buffer. The capture buffer is cleared when capture is disabled.
CLEARCAPTURE	Clear the capture buffers on all [PORTLIST] ports

For example, to capture and display active traffic on connected ports 1 & 5:

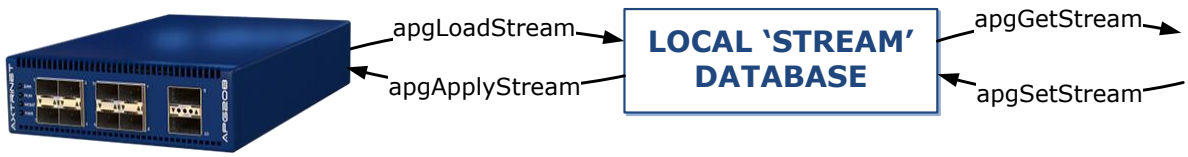
Eg:

```
set PORTLIST {{1 2}{1 5}}
apgControlPort PORTCAPTURE $PORTLIST                    Enable port (16KB) capture on both ports.

apgControlPort CLEARCAPTURE $PORTLIST                   Clear capture buffers and start transmitting
apgControlPort STARTTX $PORTLIST

foreach PORTID $PORTLIST {apgLoadPort $PORTID CAPTURE   Load 100 packets from each port buffer
BUFFER 100}

foreach SUBPORTID $PORTLIST {                           For each port, get the number of downloaded packets
    set PKTCOUNT [ apgGetPort $SUBPORTID CAPTURE PACKET
TOTALPACKETS ]

    for { set PKT 1 } { $PKT <= $PKTCOUNT } { incr PKT } {   Then display each packet.
        puts [apgGetPort $SUBPORTID CAPTURE PACKET
DATA $PKT]

    }
}
```

8.5.3 apgControlPort CLEARANALYSIS [PORTLIST]

Clear the Packet Analysis measurements on a group of ports identified by [PORTLIST].

9. STREAM COMMANDS



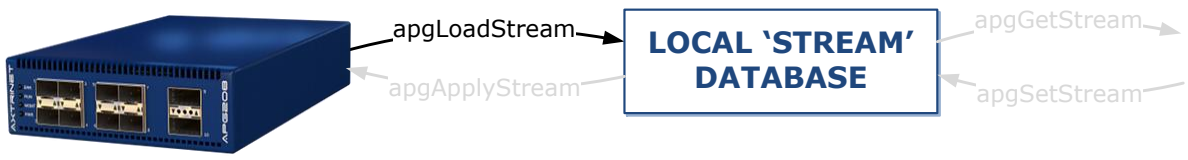
apgLoadStream	**apgLoadStream [STREAMID]**
apgGetStream	**apgGetStream [STREAMID] CONFIG [VAR]** **apgGetStream [STREAMID] HEADER HEADER_LIST** **apgGetStream [STREAMID] HEADER [HDR] [FLD]** **apgGetStream [STREAMID] PAYLOAD [VAR]**
apgSetStream	**apgSetStream [STREAMID] DEFAULT** **apgSetStream [STREAMID] CONFIG [VAR] [VAL]** **apgSetStream [STREAMID] HEADER HEADER_LIST [HDRLIST]** **apgSetStream [STREAMID] HEADER [HDR] [FLD] [VAL]** **apgSetStream [STREAMID] PAYLOAD [VAR] [VAL]**
apgApplyStream	**apgApplyStream [STREAMID]**

Where STREAMID = {UNIT.PORT.STREAM} or {UNIT.PORT.SUBPORT.STREAM}

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"          ← Load API

# Open Connection                                               Open
set IPADDRESS 192.168.1.100                                     Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST {{$UNITID 1 0} {$UNITID 2 0}}

# Configure Streams                                             Configure
puts "\nDEMO: Configure Streams"                                Streams
set STREAM 0
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  puts "      -> Port $PO"
  for { set ST 0 } { $ST < 8 } { incr ST } {
    set STREAMID [linsert $PORTID end $ST]
    if { $ST == 0 } {                                           Stream 0
      apgSetStream $STREAMID DEFAULT
      apgSetStream $STREAMID CONFIG ENABLE 1                    Enable
      apgSetStream $STREAMID CONFIG SIZE_MODE RANDOM            Random Size
      apgSetStream $STREAMID CONFIG PACKET_SIZE 64              64 -
      apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 5000         5000 bytes
      apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER"     MACHEADER
      apgSetStream $STREAMID HEADER MACHEADER DA \
        [format "08:%02d:%02d:%02d:%02d:00" $UN $PO $SP $ST]
      apgSetStream $STREAMID HEADER MACHEADER SA \
        [format "08:%02d:%02d:%02d:%02d:01" $UN $PO $SP $ST]
      apgSetStream $STREAMID PAYLOAD DATA_CONTROL RANDOM        Random Data
      if { $PO >= 9 } {                                         If 40G
        apgSetStream $STREAMID PAYLOAD DATA_CONTROL INCREMENT    Increment
        apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "01 02 03 04 05 06 07 08"   Data
      }
    } else {
      apgSetStream $STREAMID CONFIG ENABLE 0                    Disable 1-7
    }
    apgApplyStream $STREAMID                                    Apply Config
  }
}

# Close connection                                              Close
apgClose $UNITID                                                connection
```

9.1 LOAD STREAM CONFIGURATION - APGLOADSTREAM



Load the STREAM configuration and status from the hardware into the local database.

apgLoadStream returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

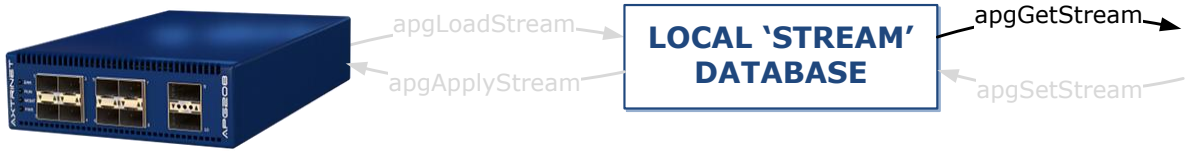
9.1.1 apgLoadStream [STREAMID]

Loads the Stream Information into the local configuration database, containing:

- Stream Configuration
  - Enable
  - Transmit, Rate and Payload Modes
  - Frame Size
- Stream Header
  - Configured Headers
  - Header Settings
- Stream Payload
  - Data, Offset and Length
  - Timestamp

The Stream Information can be read using the **apgGetStream CONFIG**, **HEADER** and **PAYLOAD** commands.

9.2 GET STREAM CONFIGURATION - APGGETSTREAM



apgGetStream returns the get value if successful, otherwise the command will display an error message and exit the TCL environment.

A stream configuration is defined by the CONFIG, HEADER and PAYLOAD:

CONFIG	Defines the stream state, packet rate and packet size
HEADER	Defines the Ethernet headers (eg MACHEADER) and fields (eg DA)
PAYLOAD	Defines the packet contents following the headers

9.2.1 apgGetStream [STREAMID] CONFIG [VAR]

The stream configuration status, rate and size information is read with the **apgGetStream CONFIG** command.

apgGetStream CONFIG must either be configured using **apgSetStream CONFIG** or be preceded by at least one **apgLoadStream**. If [VAR] has not been defined, **apgGetStream CONFIG** will display an error message and exit the TCL environment.

[VAR]	LENGTH	Description
ENABLE	8 bits	0 = Stream Disabled 1 = Stream Enabled
TX_MODE	8 bits	0 = Continuous 1 = Burst
RATE_MODE	8 bits	0 = TXGAP (Inter Frame Gap)1 = PPS (Frames Per Second) 2 = Percent
SIZE_MODE	8 bits	0 = Fixed 3 = Random
TX_CONTROL	8 bits	0 = Transmit good frames
RATE_VALUE	64 bits	If RATE_MODE = 0 (TXGAP) → TXGAP = RATE_VALUE * 8 bytes * link speed
		If RATE_MODE = 1 (Packets per Second → PPS = RATE_VALUE pps
		If RATE_MODE = 2 (PERCENT) → PERCENT = RATE_VALUE * 1000 Eg RATE_VALUE = 90500 → 90.5%
TX_BURST_SIZE	32 bits	Number of frames in the burst
TX_BURST_COUNT	32 bits	Number of bursts to transmit
TX_IBG	32 bits	Inter-burst gap (TX_IBG x 5.5ns)
PACKET_SIZE	32 bits	Total frame length (including FCS) in bytes. If SIZE_MODE is not 0 (FIXED), FRAME_SIZE defines the minimum frame length for the increment, decrement or random size.
PACKET_SIZE_MAX	32 bits	Maximum frame length (including FCS) in bytes for the increment, decrement or random size modes. If SIZE_MODE is 0 (FIXED) this value is ignored.

9.2.2 apgGetStream [STREAMID] HEADER HEADER_LIST

Returns a list of configured header names in the order that the headers appear in the frame.

apgGetStream HEADER HEADER_LIST must either be configured using **apgSetStream HEADER HEADER_LIST** or be preceded by at least one **apgLoadStream**. If [VAR] has not been defined, **apgGetStream HEADER HEADER_LIST** will display an error message and exit the TCL environment.

For example, the minimum set of ethernet headers is:

MACHEADER ETHERNET_II USERDEFINED

The full list of headers is defined in the latest Header Definition document [3].

For example: A header structure containing a MAC Header [MACHEADER] and an Ethertype [ETHERNET-II] will return "MACHEADER ETHERNET-II"

The maximum number of headers in the header list is 10.

The maximum length of the headers is 64 bytes.

9.2.3 apgGetStream [STREAMID] HEADER [HDR] [FLD]

Returns the value of a header field configuration.

apgGetStream HEADER must either be configured using **apgSetStream HEADER** or be preceded by at least one **apgLoadStream**. If [FLD] has not been defined, **apgGetStream HEADER** will display an error message and exit the TCL environment.

The returned value depends on the configuration mode (FIX, INC etc).

apgGetStream HEADER returns a single value if [MODE] is FIXed.

apgGetStream HEADER returns a list if [MODE] is not FIXed, containing the following fields:

"[VAL] [MODE] [MIN] [STEP] [MAX]"

Where:

Variable	Description	
[VAL]	Initial Value	
[MODE]	The header field modes are defined in the Header Definition document [3]. For example, the MACHEADER DA modes are "FIX INC" where:	
	FIX	Fixed [FLD] value [VAL]
	INC	Incrementing [FLD] value [VAL], starting at [VAL] with each byte incrementing to [MAX], wrapping to [MIN] to continue incrementing
[MIN]	Minimum range for INC [FLD] value wraps to [MAX] in decrementing mode.	
[STEP]	Byte-wise step	
[MAX]	Maximum range for INC . [FLD] value wraps to [MIN] (zero) in incrementing mode.	

The full list of [HDR] headers is defined in the latest Header Definition document [3].

The header fields [FLD] for the basic set of ethernet headers are shown below as examples. The full list of headers is defined in the latest Header Definition document [3].

apgGetStream HEADER returns the variable value in the following formats:

Format	Minimum	Maximum	Comments
MAC-ADDRESS	00:00:00:00:00:00	FF:FF:FF:FF:FF:FF	
HEX4	0x0	0xFFFF	
HEX2ARRAY	0x0	0xFF	Variable length HEX2 values separated by spaces

9.2.3.1 MACHEADER

[FLD]	DESC	SIZE	FORMAT	MODE
DA	MAC Destination Address	6 bytes	MAC-ADDRESS	FIX INC
SA	MAC Source Address	6 bytes	MAC-ADDRESS	FIX INC

9.2.3.2 ETHERNET_II

[FLD]	DESC	SIZE	FORMAT	MODE
ETHERTYPE	Ethernet-II Type	2 bytes	HEX4	FIX INC

9.2.3.3 USERDEFINED

The USERDEFINED header is a variable length configurable field that can be used to implement any fixed custom header field.

[FLD]	DESC	SIZE	FORMAT	MODE
DATA	Data Values	Variable	HEX2ARRAY	--

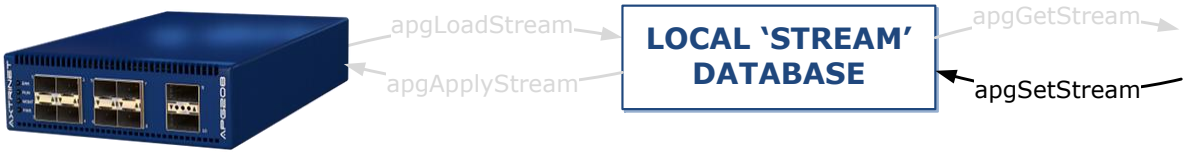
9.2.4 apgGetStream [STREAMID] PAYLOAD [VAR]

Returns the value of the payload fields.

apgGetStream PAYLOAD must either be configured using **apgSetStream PAYLOAD** or be preceded by at least one **apgLoadStream**. If [VAR] has not been defined, **apgGetStream PAYLOAD** will display an error message and exit the TCL environment.

[VAR]	LENGTH	Description
PAYLOAD_DATA	12 Char	Payload values
DATA_CONTROL	8 bits	FIXED, RANDOM, INCREMENT, DECREMENT

9.3 SET STREAM CONFIGURATION - APGSETSTREAM



apgSetStream returns the set value if successful, otherwise the command will display an error message and exit the TCL environment.

A stream configuration is made up of three parts:

- **apgSetStream CONFIG**
- **apgSetStream HEADER**
- **apgSetStream PAYLOAD**

All three parts have to be correctly defined to successfully configure a stream.

It is recommended that a default stream is created using **apgSetStream DEFAULT** to ensure that all of the variables correctly are defined, then modifying the default configuration.

The stream configuration is applied to the unit using **apgApplyStream**.

Eg:

```
# Instantiate APG TCL API (Windows)
source "C:/Program Files/Axtrinet/APG/axtrinetApi.tcl"          ← Load API

# Open Connection                                               Open
set IPADDRESS 192.168.1.100                                     Connection
set UNITID [apgOpen $IPADDRESS]
set PORTLIST {{$UNITID 1 0} {$UNITID 2 0}}

# Configure Streams                                             Configure
puts "\nDEMO: Configure Streams"                                Streams
set STREAM 0
foreach PORTID $PORTLIST {
  scan $PORTID "%d %d %d" UN PO SP
  puts "      -> Port $PO"
  for { set ST 0 } { $ST < 8 } { incr ST } {
    set STREAMID [linsert $PORTID end $ST]
    if { $ST == 0 } {                                           Stream 0
      apgSetStream $STREAMID DEFAULT
      apgSetStream $STREAMID CONFIG ENABLE 1                    Enable
      apgSetStream $STREAMID CONFIG SIZE_MODE RANDOM            Random Size
      apgSetStream $STREAMID CONFIG PACKET_SIZE 64              64 -
      apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 5000         5000 bytes
      apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER"     MACHEADER
      apgSetStream $STREAMID HEADER MACHEADER DA \
        [format "08:%02d:%02d:%02d:%02d:00" $UN $PO $SP $ST]
      apgSetStream $STREAMID HEADER MACHEADER SA \
        [format "08:%02d:%02d:%02d:%02d:01" $UN $PO $SP $ST]
      apgSetStream $STREAMID PAYLOAD DATA_CONTROL RANDOM        Random Data
      if { $PO >= 9 } {                                         If 40G
        apgSetStream $STREAMID PAYLOAD DATA_CONTROL INCREMENT    Increment
        apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "01 02 03 04 05 06 07 08"   Data
      }
    } else {
      apgSetStream $STREAMID CONFIG ENABLE 0                    Disable 1-7
    }
    apgApplyStream $STREAMID                                    Apply Config
  }
}

# Close connection                                              Close
apgClose $UNITID                                                connection
```

9.3.1 apgSetStream [STREAMID] DEFAULT

Sets the STREAMID configuration to default settings, with the following exceptions:

- STREAM 0 is ENABLED
- MAC DA is set to 08:$PORTID:$SUBPORTID:$STREAMID:00:00
- MAC SA is set to 08:$PORTID:$SUBPORTID:$STREAMID:00:01

9.3.2 apgSetStream [STREAMID] CONFIG [VAR] [VAL]

The **apgSetStream CONFIG** command allows configuration of the stream state, transmit mode, rate mode and packet size settings.

The [VAR] and [VAL] fields can be:

[VAR]	Description	Default	FORMAT
ENABLE	0 = Stream Disabled 1 = Stream Enabled	0	HEX2
TX_MODE	CONTINUOUS (0) BURST (1) MULTIBURST (2)	CONTINUOUS	
TX_BURST_SIZE	Number of frames in the burst	1	INT
TX_BURST_COUNT	Number of bursts to transmit	1	INT
TX_IBG	Inter-burst gap (x5.5ns)	0	INT
RATE_MODE	TXGAP Pseudo-IPG at internal clock frequency PPS Packets per Second PERCENT % maximum bit rate	TXGAP	
RATE_VALUE	If RATE_MODE = TXGAP → TXGAP = RATE_VALUE * 8 bytes * link speed	0	INT
	If RTE_MODE = PPS → PPS = RATE_VALUE pps		INT
	If RATE_MODE = PERCENT → PERCENT = RATE_VALUE * 1000 Eg RATE_VALUE = 90500 → 90.5%		INT
SIZE_MODE	FIXED = Fixed **PACKET_SIZE** byte packets RANDOM = Random length packets between **PACKET_SIZE** and **PACKET_SIZE_MAX** bytes. If **PACKET_SIZE_MAX** is not defined, fixed length **PACKET_SIZE** byte packets will be generated.	FIXED	
PACKET_SIZE	Total packet length (including FCS) in bytes. If SIZE_MODE is not 0 (FIXED), FRAME_SIZE defined the minimum frame length for the increment, decrement or random size. 32 ≤ **PACKET_SIZE** ≤ 16000 bytes If PACKET_SIZE < 32 → 32 If PACKET_SIZE < 16000 → 16000 Packet sizes < 64 bytes will be counted as UNDERSIZE packets.	100	INT

[VAR]	Description	Default	FORMAT
PACKET_SIZE_MAX	Maximum packet length (including FCS) in bytes. If SIZE_MODE is 0 (FIXED) this value is ignored. **PACKET_SIZE_MAX** ≤ 16000 bytes Larger values will be set to 16000.	100	INT

Where variable FORMAT has the follow settings:

FORMAT	Min	Max	
INT	0	N/A	
HEX2	0x0	0xFF	(256 dec)
HEX4	0x0	0xFFFF	(65,535 dec)
HEX8	0x0	0xFFFFFFFF	(4,294,967,296 dec)

9.3.3 apgSetStream [STREAMID] HEADER HEADER_LIST [HDRLIST]

Sets the configured headers in the order that the headers appear in the frame.

For example: A header structure containing a MAC Header [MACHEADER] and an Ethertype [ETHERNET-II] is defined with [HDRLIST] set to "MACHEADER ETHERNET-II"

The full list of headers is defined in the latest Header Definition document [3].

The maximum number of headers in the header list is 10.

The maximum length of the headers is 64 bytes.

9.3.4 apgSetStream [STREAMID] HEADER [HDR] [FLD] [VAL]

Sets the value of a FIXED header field, where:

Variable	Description
[HDR]	The full list of [HDR] headers is defined in the latest Header Definition document [3].
[FLD]	The full list of headers fields [FLD] are defined in the latest Header Definition document [3]
[VAL]	Value to be set

apgSetStream variables are set in the following formats:

Format	Minimum	Maximum	Comments
MAC-ADDRESS	00:00:00:00:00:00	FF:FF:FF:FF:FF:FF	
INT	0		Depends on FLD 'size'
HEX2	0x0	0xFF	
HEX4	0x0	0xFFFF	
HEX2ARRAY	0x0	0xFF	Variable length HEX2 values separated by spaces

The maximum total header length is 64 bytes.

9.3.4.1 MACHEADER

[FLD]	DESC	SIZE	FORMAT
DA	MAC Destination Address	6 bytes	MAC-ADDRESS
SA	MAC Source Address	6 bytes	MAC-ADDRESS

Eg:
```
apgSetStream {1 1 0 1} HEADER MACHEADER DA 01:23:45:67:89:AB
apgApplyStream {1 1 0 1}
```

9.3.4.2 ETHERNET_II

[FLD]	DESC	SIZE	FORMAT
ETHERTYPE	Ethernet-II Type	2 bytes	HEX4

Eg:
```
apgSetStream {1 3 0 5} HEADER ETHERNET-II ETHERTYPE 0x0800
apgApplyStream {1 3 0 5}
```

9.3.4.3 USERDEFINED

The USERDEFINED header is a variable length configurable field that can be used to implement any fixed custom header field.

[FLD]	DESC	SIZE	FORMAT
DATA	Data Values	Variable	HEX2ARRAY

Eg:
```
apgSetStream {2 2 0 3} HEADER USERDEFINED "00 11 22 33 44 55"
apgApplyStream {2 2 0 3}
```

9.3.5 apgSetStream [STREAMID] HEADER [HDR] [FLD] [VAL] [MODE] [STEP][MIN][MAX]

Sets the value of a VARIABLE header field, where:

Variable	Description	
[HDR]	The full list of [HDR] headers is defined in the latest Header Definition document [3].	
[FLD]	The header fields [FLD] are defined in the Header Definition document [3]	
[VAL]	Value to be set	
[MODE]	The header field modes are defined in the Header Definition document [3]. For example, the MACHEADER DA modes are:	
	FIX	Fixed [FLD] value [VAL]
	INC	Incrementing [FLD] value [VAL], starting at [VAL] with each byte incrementing to [MAX], wrapping to [MIN] to continue incrementing
[STEP]	Byte-wise step	
[MIN]	Minimum range for INC **Always zero in APG TCL API V1.0 Software.** [FLD] value wraps to [MAX] in decrementing mode.	
[MAX]	Maximum range for INC . [FLD] value wraps to [MIN] (zero) in incrementing mode.	

9.3.6 apgSetStream [STREAMID] PAYLOAD [VAR] [VAL]

Sets the value of the payload fields.

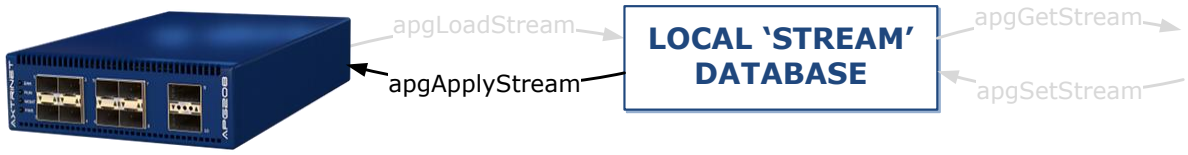
apgGetStream PAYLOAD must either be configured using **apgSetStream PAYLOAD** or be preceded by at least one **apgLoadStream**. If [VAR] has not been defined, **apgGetStream PAYLOAD** will display an error message and exit the TCL environment.

[VAR]	Description	Default	RANGE
DATA_CONTROL	FIXED, RANDOM, INCREMENT, DECREMENT	FIXED	
PAYLOAD_DATA	Payload values	00	HEX2ARRAY
TS_ENABLE	Timestamp Control 0 = Disabled 1 = Enabled	0	INT

Where variable FORMAT has the follow settings:

FORMAT	Min	Max	
HEX2ARRAY	0x0	0xFF	12-byte HEX2 values separated by spaces

9.4 APPLY STREAM CONFIGURATION - APGAPPLYSTREAM



apgApplyStream returns 1 if successful, otherwise the command will display an error message and exit the TCL environment.

9.4.1 apgApplyStream [STREAMID]

Applies the STREAM CONFIG, HEADER and PAYLOAD configurations to the unit.

10. TOOLS

The following tools are provided to simplify access to the local data structures.

10.1 COMMAND TOOLS

10.1.1 apgGetVariables [COMMAND] {FUNCTION}

Returns a space-separated string of valid variables for a command, where:

COMMAND	FUNCTION
VERSION	--
UNIT	INFO STATUS
PORT	INFO STATUS TXSTATS RXSTATS RATES SETPORTCONFIG
STREAM	CONFIG PAYLOAD

For example, to get the apgGetUnit STATUS variables:

Eg:
```
apgGetVariables UNIT STATUS
```
→ **"UPTIME TEMP FAN SELFTEST READY"**

apgGetVariables can be used to load variables from the local database:

Eg:
```
foreach VAR [apgGetVariables UNIT INFO] {
    set $VAR [apgGetUnit $UNITID INFO $VAR]
}
puts $SERIAL
puts $PRODUCT
```
→ APG000006
→ APG208

10.2 HEADER TOOLS

10.2.1 apgGetHeaderList [STREAMID]

Returns a space-separated string of headers configured for stream STREAMID.

Eg:
```
apgGetHeaderList { 1 1 0 1 }
```
→ "MACHEADER VLAN_INNER ETHERNET_II"

10.2.2 apgGetHeaderFieldList [HDR]

Returns a space-separated string of fields for the headers configured for stream STREAMID.

Eg:

```
set STREAMID { 1 1 0 2 }
apgLoadStream $STREAMID

set HEADERLIST [apgGetHeaderList $STREAMID]

foreach HDR $HEADERLIST {
  puts "$HDR:[apgGetHeaderFieldList $HDR]"

}
```

```
→ "MACHEADER ETHERNET_II"

→ MACHEADER: DA SA
→ ETHERNET_II: ETHERTYPE
```

10.2.3 apgGetHeaderFieldValue [HDR] [FLD] [VAR]

Returns the value of the header structure field variable, where VAR:

VAR	
LABEL	Header field name
DESCRIPTION	Field description
LENGTH	Length (integer)
SCALE	Scale (eg bits, bytes)
FORMAT	See **apgSetStream** (Section 9.3)
EDITABLE	0 = Fixed (value cannot be changed) 1 = Editable

Eg:

```
set STREAMID { 1 1 0 0 }
apgLoadStream $STREAMID
set HEADERLIST [apgGetHeaderList $STREAMID]

foreach HDR $HEADERLIST {

    set FIELDLIST [apgGetHeaderFieldList $HDR]

    foreach FLD $FIELDLIST {

        foreach VAR { DESCRIPTION LENGTH SCALE FORMAT } {
            set $VAR [apgGetHeaderFieldValue $HDR $FLD $VAR]
        }

        Puts "$HDR $FLD \($DESCRIPTION\)"
        puts " -> $LENGTH $SCALE \($FORMAT\)"

        }
    }
}
```

Displays:

```
MACHEADER DA (MAC Destination Address)
-> 6 bytes (mac-address)
MACHEADER SA (MAC Source Address)
-> 6 bytes (mac-address)

ETHERNET_II ETHERTYPE (The encapsulated protocol type >= 0x600)
-> 2 bytes (hex4)
```

APPENDIX A - QUICK REFERENCE GUIDE

TCL API VERSION	[VAR]
apgGetApiVersion [VAR]	COMPANY BRAND DESCRIPTION VERSION BUILD_DATE API_VERSION
CONNECTION	**[VAR]**
apgOpen [IP-ADDRESS]	
➔ apgClose [UNITID]	
CONFIGURATION	**[VAR]**
apgSaveConfiguration [UNITID] [PORTLIST] {FILENAME}	Eg PORTLIST = "{{1 2}{1 4}}" or ALL
apgApplyConfiguration [UNITID] [FILENAME]	
UNIT COMMANDS	**[VAR]**
apgLoadUnit [UNITID] INFO	
➔ apgGetUnit [UNITID] INFO [VAR]	API_VERSION PORT_COUNT API_MINIMUM SERIAL PRODUCT HWARE_VERSION FPGA_VERSION FPGA_BUILDDATE FIRMWARE_VERSION FIRMWARE_BUILDDATE
apgLoadUnit [UNITID] STATUS	
➔ apgGetUnit [UNITID] STATUS [VAR]	UPTIME TEMP FAN SELFTEST READY
PORT COMMANDS	**[VAR]**
apgLoadUnit [UNITID] PORTSTATUS	
➔ apgGetPort [PORTID] STATUS [VAR]	LINK MODULE_STATUS SPEED MODULE_SEQUENCE MODULE_TYPE MODULE_CLASS MODULE_TEMP
apgLoadPort [PORTID] INFO	
➔ apgGetPort [PORTID] INFO [VAR]	PORTNAME SPEEDCAP NSUBPORTS NSTREAMS
apgLoadPort [PORTID] MODULE	
➔ apgGetPort [PORTID] MODULE [VAR]	MODULE_TYPE ID VENDOR_ID VENDOR_NAME VENDOR_PN VENDOR_REV VENDOR_SN DATECODE

apgSetPort [PORTID] [VAR] [VAL]	**DEFAULT** **TOPOLOGY** **RATE** **TXENABLE** **LINKMODE** **PORTNAME**
➔ apgApplyPort [PORTID]	**STATE**
apgControlPort [COMMAND] [PORTLIST]	**STARTTX** **STEPTX** **PAUSETX** **STOPTX** **CLEARCOUNTERS** **PORTCAPTURE** **DISABLECAPTURE** **CLEARCAPTURE** **CLEARANALYSIS**
apgLoadUnit [UNITID] COUNTERS	
➔ apgGetPort [PORTID] TXSTATS [VAR]	**TIMESTAMP** **BYTES** **GOOD_FRAMES** **PKT_64** **PKT_65_128** **PKT_129_256** **PKT_257_512** **PKT_513_1024** **PKT_1025_1536** **PKT_1537_9000** **PKT_9001_MAX** **TX_RUNTIME**
➔ apgGetPort [PORTID] RXSTATS [VAR]	**TIMESTAMP** **BYTES** **GOOD_FRAMES** **PKT_UNDERSIZE** **PKT_FRAGMENTS** **PKT_FCSERROR** **PKT_NOSFD** **PKT_64** **PKT_65_128** **PKT_129_256** **PKT_257_512** **PKT_513_1024** **PKT_1025_1536** **PKT_1537_9000** **PKT_9001_MAX** **FILTER1** **FILTER2** **FILTER3** **FILTER4**
apgLoadUnit [UNITID] RATES	
➔ apgGetPort [PORTID] RATES [VAR]	**TXPKTRATE** **TXBYTERATE** **TXBITRATE** **RXPKTRATE** **RXERRORRATE** **RXBYTERATE** **RXBITRATE**
apgLoadPort [PORTID] CAPTURE	
➔ apgGetPort [PORTID] CAPTURE CONFIG [VAR]	**AVAILABLE** **BUFFERSIZE** **FLAGS**
➔ apgGetPort [PORTID] CAPTURE PACKET	**TOTALPACKETS** **TIMESTAMP** **TSMODE** **LENGTH** **PKTERROR** **DATA**

apgLoadPort [PORTID] CAPTURE	
➔ apgGetPort [PORTID] ANALYSIS TXTX [VAR] **➔ apgGetPort [PORTID] ANALYSIS TXRX [VAR]** **➔ apgGetPort [PORTID] ANALYSIS RXRX [VAR]**	**CYCLES** **SAMPLES** **LIST** **MIN** **MAX** **MEAN** **MODE** **STDDEV**
➔ apgGetPort [PORTID] ANALYSIS SEQUENCE [VAR]	**CYCLES** **SAMPLES** **LIST** **MIN** **MAX** **RANGE** **MONOTONIC** **RPTCOUNT** **GAPCOUNT** **OOOCOUNT**
STREAM COMMANDS	**[VAR]**
apgLoadStream [STREAMID]	
➔ apgGetStream [STREAMID] CONFIG [VAR]	**ENABLE** **TX_MODE** **TX_CONTROL** **TX_BURST_SIZE** **TX_BURST_COUNT** **TX_BURST_IBG** **RATE_MODE** **RATE_VALUE** **SIZE_MODE** **PACKET_SIZE** **PACKET_SIZE_MAX**
➔ apgGetStream [STREAMID] HEADER HEADER_LIST	
➔ apgGetStream [STREAMID] HEADER [HDR] [FLD]	See Header Definition document [3] Eg for MACHEADER: **MACHEADER DA** **MACHEADER SA**
➔ apgGetStream [STREAMID] PAYLOAD [VAR]	**PAYLOAD_DATA** **DATA_CONTROL**
apgSetStream [STREAMID] DEFAULT	
➔ apgApplyStream [STREAMID]	
apgSetStream [STREAMID] CONFIG [VAR] [VAL]	**ENABLE** **TX_MODE** **TX_BURST_SIZE** **TX_BURST_COUNT** **TX_BURST_IBG** **RATE_MODE** **RATE_VALUE** **SIZE_MODE** **PACKET_SIZE** **PACKET_SIZE_MAX**
➔ apgApplyStream [STREAMID]	

apgSetStream [STREAMID] HEADER HEADER_LIST [HDRLIST]	Eg **"MACHEADER ETHERNET-II"**
➔ apgApplyStream [STREAMID]	
apgSetStream [STREAMID] HEADER [HDR] [FLD] [VAL]	See Header Definition document [3] Eg for MACHEADER: **MACHEADER DA 08:00:00:11:22:33** **MACHEADER SA 08:00:00:11:22:34**
➔ apgApplyStream [STREAMID]	
apgSetStream [STREAMID] HEADER [HDR] [FLD] [VAL] [MODE] [STEP][MIN][MAX]	See Header Definition document [3] Eg for MACHEADER DA: **MACHEADER DA 08:00:00:11:22:33** **INC 0:0:1:1:1:1 0:0:0:0:0:0** **FF:FF:FF:FF:FF:FF**
➔ apgApplyStream [STREAMID]	
apgSetStream [STREAMID] PAYLOAD [VAR] [VAL]	**PAYLOAD_DATA** **DATA_CONTROL**
➔ apgApplyStream [STREAMID]	
TOOLS	**Options**
apgGetVariables [COMMAND] {FUNCTION}	**VERSION** **UNIT INFO** **UNIT STATUS** **PORT INFO** **PORT STATUS** **PORT TXSTATS** **PORT RXSTATS** **PORT RATES** **PORT SETPORTCONFIG** **STREAM CONFIG** **STREAM PAYLOAD**
apgGetHeaderList [STREAMID]	
apgGetHeaderFieldList [HDR]	See Header Definition document [3] Eg **HDR = MACHEADER**
apgGetHeaderFieldValue [HDR] [FLD] [VAR]	See Header Definition document [3] **LABEL** **DESCRIPTION** **LENGTH** **SCALE** **FORMAT** **EDITABLE**

APPENDIX B - SAMPLE APGSAVECONFIGURATION FILE

The output file from **apgSaveConfiguration [UNITID] [PORTLIST] {FILENAME}** is shown below. In this example, the default filename [SERIAL].apg was generated.

```
# FILENAME: APG000010.apg
```

The unit constraints API_VERSION and PRODUCT are mandatory, and the corresponding **apgApplyConfiguration [UNITID] [FILENAME]** will fail if either are missing, or do not match in the target unit [UNITID]. API_VERSION and PRODUCT **must** be in the following format:

```
# API_VERSION 160629
# PRODUCT     APG208
```

The UNITID in the saved file is not a valid TCL construct, and is automatically replaced with the **apgSaveConfiguration [UNITID]** command.

Eg: If [UNITID] = 4, `set PORTID {UNITID 1}` is processed as `set PORTID {4 1}`

The full configuration file APG000010.apg is shown below:

```
################################################################################
#
# FILENAME: APG000010.apg
#
# Generated on Mon, 08 Aug 2016 at 14:27:05
#
# AXTRINET APG000010 CONFIGURATION FILE
#
################################################################################

# UNIT CONSTRAINTS ############################################################

# API_VERSION 160629                                                  Unit API Version and
# PRODUCT     APG208                                                  Product Type.

# PORT 1 ######################################################################

set PORTID {UNITID 1}                                                 Port Configuration for
                                                                      Unit UNITID Port 1
apgSetPort $PORTID UPDATE 6
apgSetPort $PORTID MODULE_STATUS 113
apgSetPort $PORTID SPEED 8

apgApplyPort $PORTID STATE                                            Apply port config

# STREAM 1.0.0 ################################

                                                                      Stream Configuration
set STREAMID {UNITID 1 0 0}                                           for Port 1.0 Stream 0

apgSetStream $STREAMID CONFIG ENABLE 1                                Stream configuration
apgSetStream $STREAMID CONFIG TX_MODE 0
apgSetStream $STREAMID CONFIG RATE_MODE 2
apgSetStream $STREAMID CONFIG SIZE_MODE 3
apgSetStream $STREAMID CONFIG TX_CONTROL 0
apgSetStream $STREAMID CONFIG RATE_VALUE 86015
apgSetStream $STREAMID CONFIG TX_BURST_SIZE 1
apgSetStream $STREAMID CONFIG TX BURST COUNT 1
apgSetStream $STREAMID CONFIG TX IBG 1
apgSetStream $STREAMID CONFIG PACKET_SIZE 64
apgSetStream $STREAMID CONFIG PACKET_SIZE_MAX 16000

apgSetStream $STREAMID HEADER HEADER_LIST "MACHEADER VLAN_INNER VLAN_INNER \     Stream Header List
  VLAN_INNER VLAN_INNER ETHERNET_II USERDEFINED16"                    Header Configurations

apgSetStream $STREAMID HEADER MACHEADER DA 00:DD:01:01:00:00          MACHEADER
apgSetStream $STREAMID HEADER MACHEADER SA 00:55:01:01:00:00 INC 01:02:03:04:05:06 \
  00:00:00:00:00:00 0A:0B:0C:0D:0E:0F
```

```
apgSetStream $STREAMID HEADER VLAN_INNER PROTOCOL_ID 0x8100                    VLAN #1
apgSetStream $STREAMID HEADER VLAN_INNER PRIORITY 0
apgSetStream $STREAMID HEADER VLAN_INNER CFI 0
apgSetStream $STREAMID HEADER VLAN_INNER VID 1 INC 0 1 4095

apgSetStream $STREAMID HEADER VLAN_INNER/2 PROTOCOL_ID 0x8101                  VLAN #2
apgSetStream $STREAMID HEADER VLAN_INNER/2 PRIORITY 0
apgSetStream $STREAMID HEADER VLAN_INNER/2 CFI 0
apgSetStream $STREAMID HEADER VLAN_INNER/2 VID 1 INC 0 2 10

apgSetStream $STREAMID HEADER VLAN_INNER/3 PROTOCOL_ID 0x8102                  VLAN #3
apgSetStream $STREAMID HEADER VLAN_INNER/3 PRIORITY 0
apgSetStream $STREAMID HEADER VLAN_INNER/3 CFI 0
apgSetStream $STREAMID HEADER VLAN_INNER/3 VID 1

apgSetStream $STREAMID HEADER VLAN_INNER/4 PROTOCOL_ID 0x8103                  VLAN #4
apgSetStream $STREAMID HEADER VLAN_INNER/4 PRIORITY 0
apgSetStream $STREAMID HEADER VLAN_INNER/4 CFI 0
apgSetStream $STREAMID HEADER VLAN_INNER/4 VID 1 INC 0 4 30

apgSetStream $STREAMID HEADER ETHERNET_II ETHERTYPE 0x0812                     ETHERNET_II

apgSetStream $STREAMID HEADER USERDEFINED16 DATA 0x0000 INC 0x0010 0x0000 0x2000   USERDEFINED16

apgSetStream $STREAMID PAYLOAD PAYLOAD_DATA "00 00 00 00 00 00 00 00"          Payload configuration
apgSetStream $STREAMID PAYLOAD DATA_CONTROL 0
apgSetStream $STREAMID PAYLOAD TIMESTAMP_CONTROL 0

apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.1 ###################################

set STREAMID {UNITID 1 0 1}                                                    Stream 1
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.2 ###################################

set STREAMID {UNITID 1 0 2}                                                    Stream 2
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.3 ###################################

set STREAMID {UNITID 1 0 3}                                                    Stream 3
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.4 ###################################

set STREAMID {UNITID 1 0 4}                                                    Stream 4
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.5 ###################################

set STREAMID {UNITID 1 0 5}                                                    Stream 5
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.6 ###################################

set STREAMID {UNITID 1 0 6}                                                    Stream 6
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# STREAM 1.0.7 ###################################

set STREAMID {UNITID 1 0 7}                                                    Stream 7
apgSetStream $STREAMID CONFIG ENABLE 0                                         ... Disabled
apgApplyStream $STREAMID                                                       Apply stream config

# END OF FILE ####################################################################
```

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